

April 10, 1962

C. HEPNER
PACKAGING MACHINE

3,029,007

Filed April 13, 1959

17 Sheets-Sheet 1

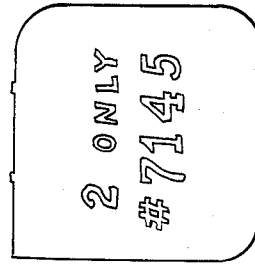
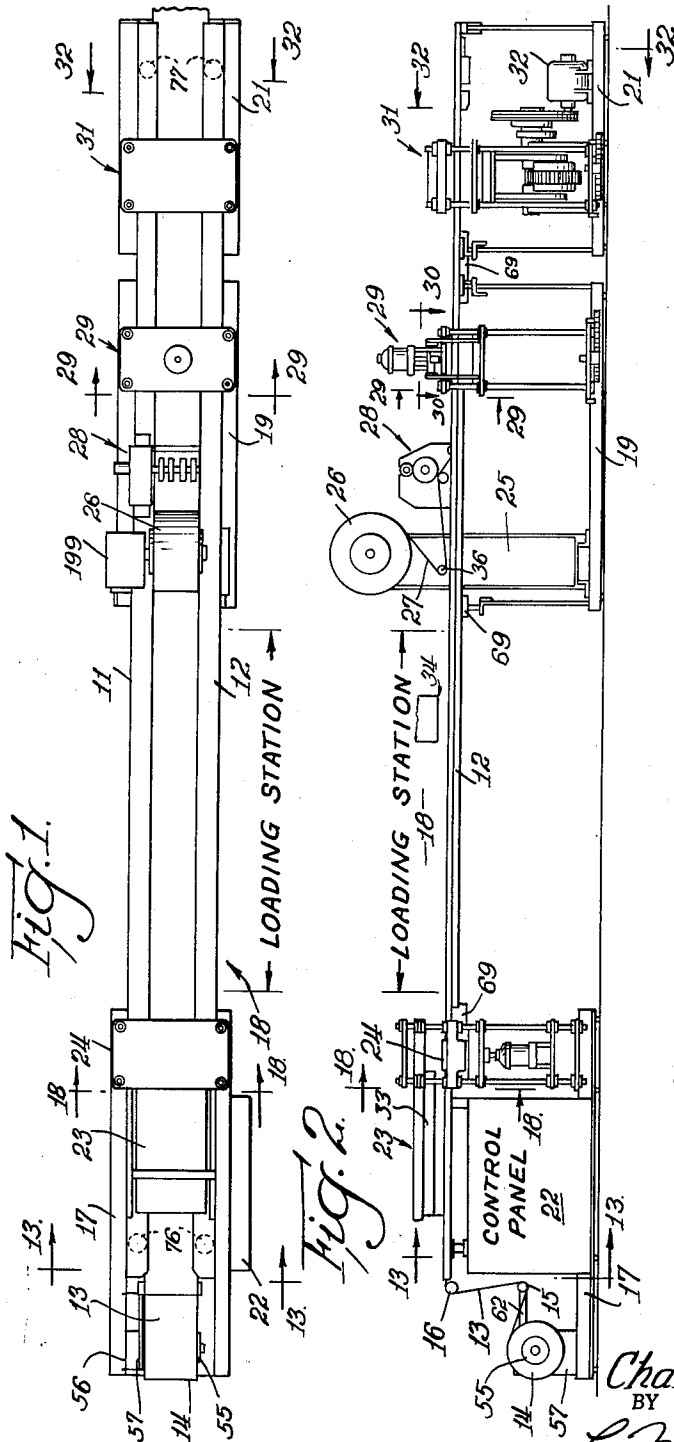
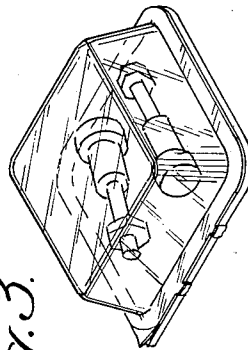


Fig. 4

Fig. 3



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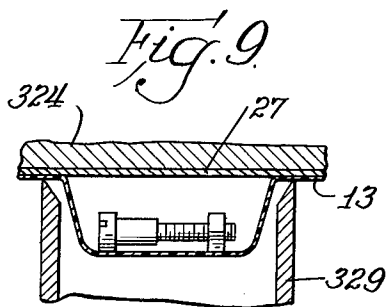
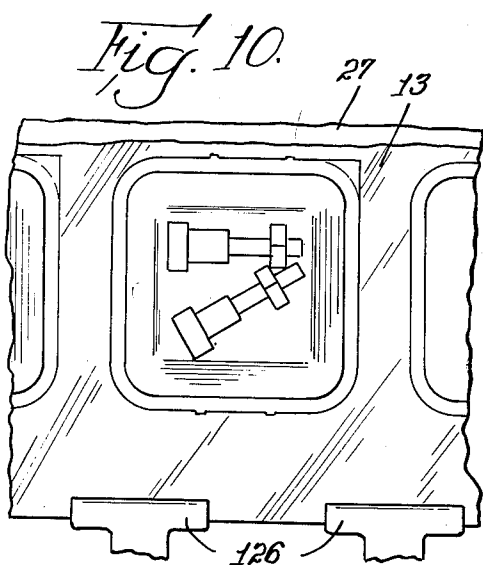
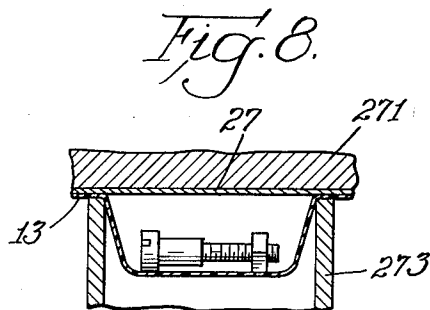
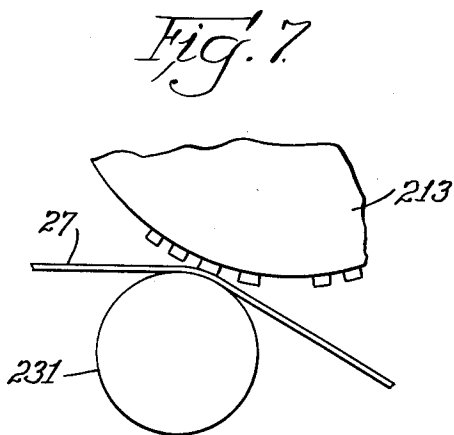
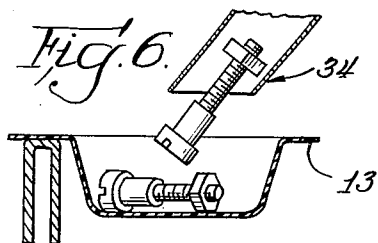
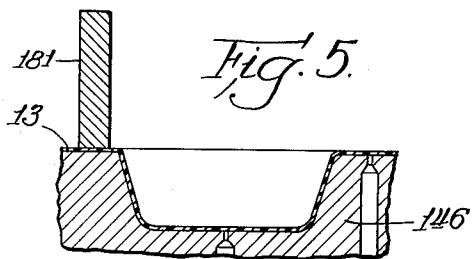
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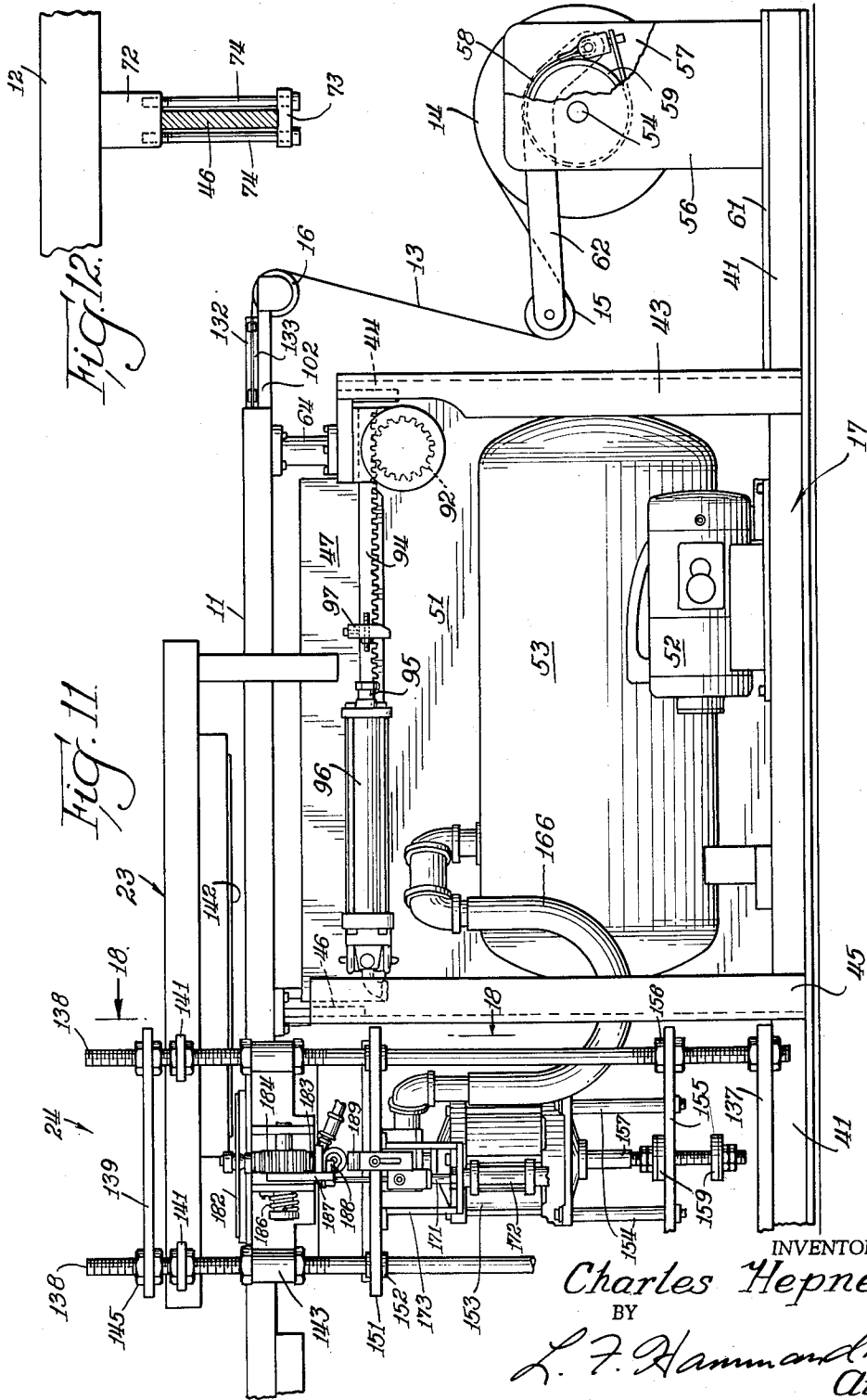
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PACKAGING MACHINE

Filed April 13, 1959

17 Sheets-Sheet 3



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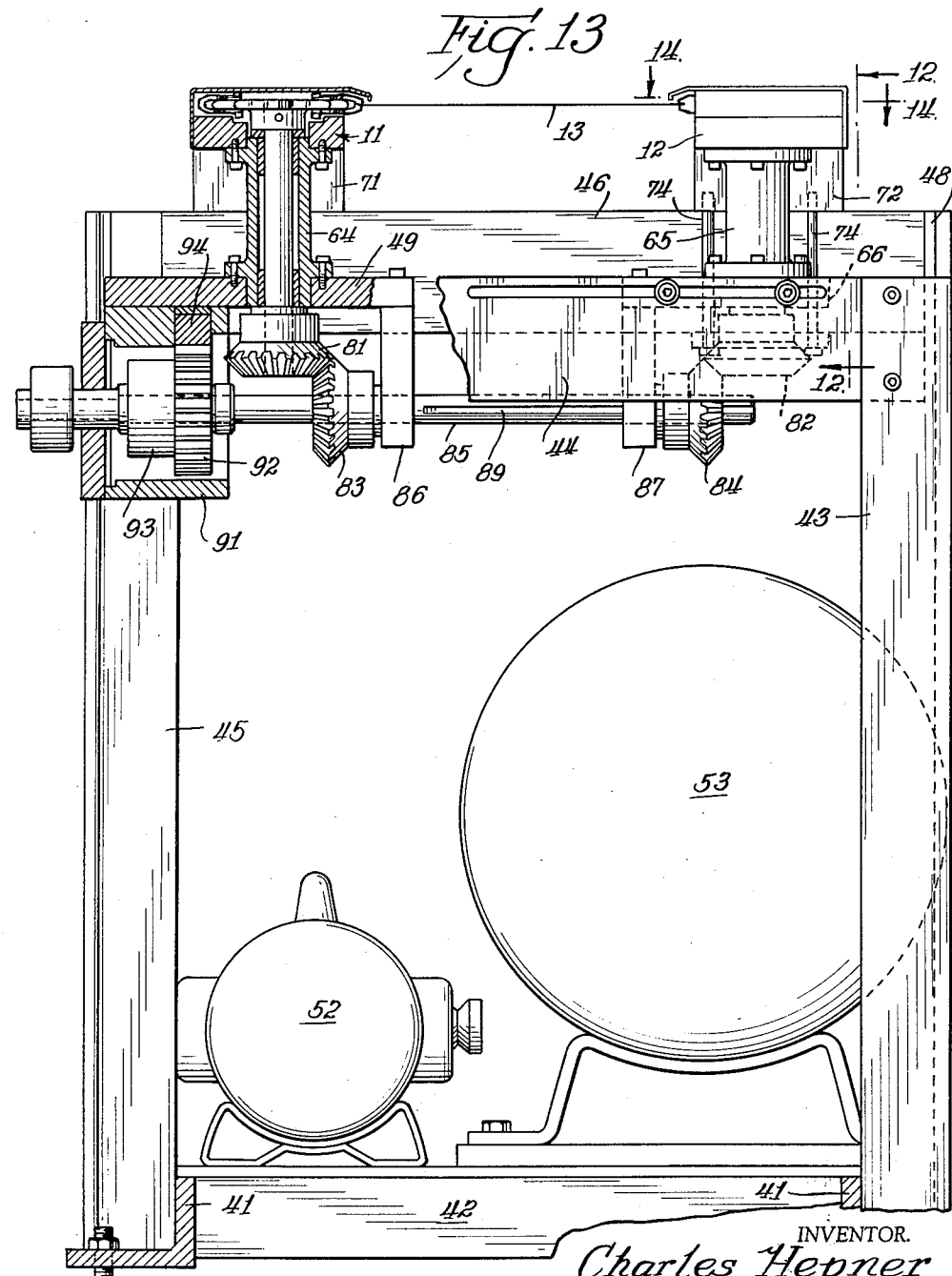
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17 Sheets-Sheet 4



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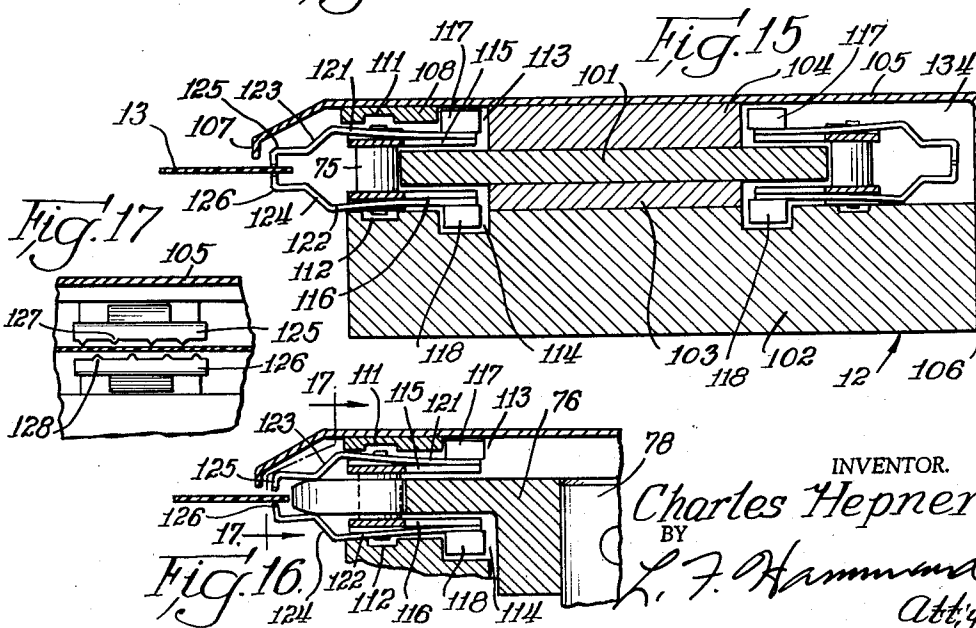
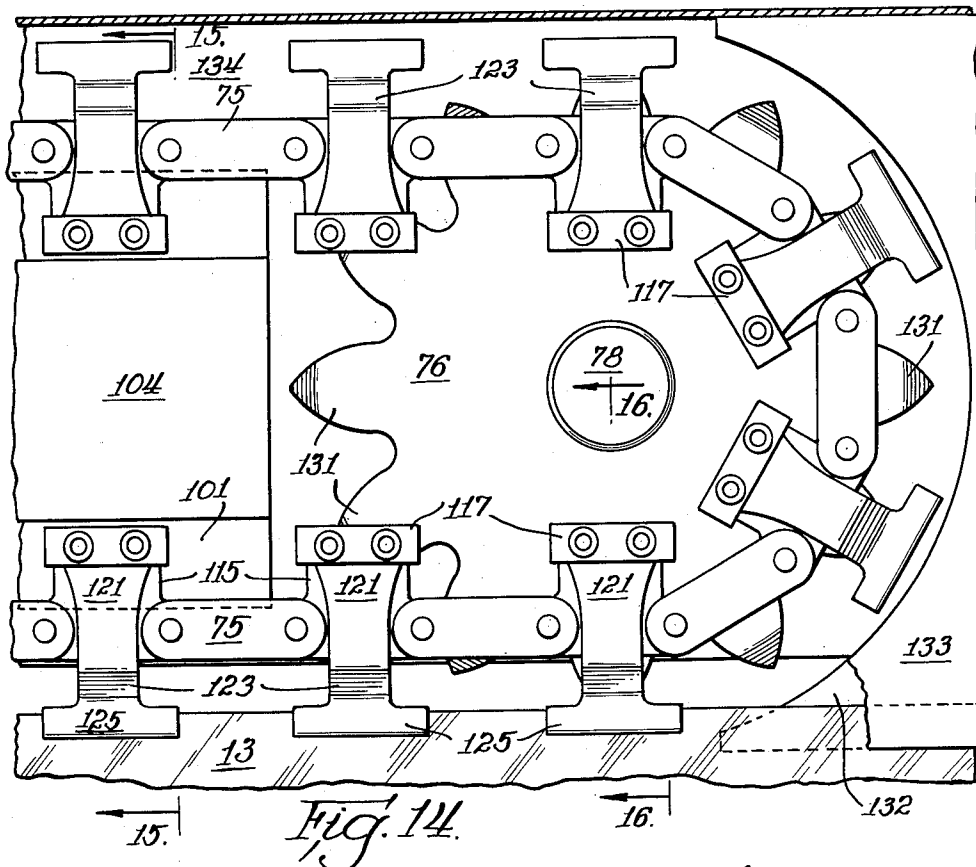
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PACKAGING MACHINE

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17 Sheets-Sheet 5



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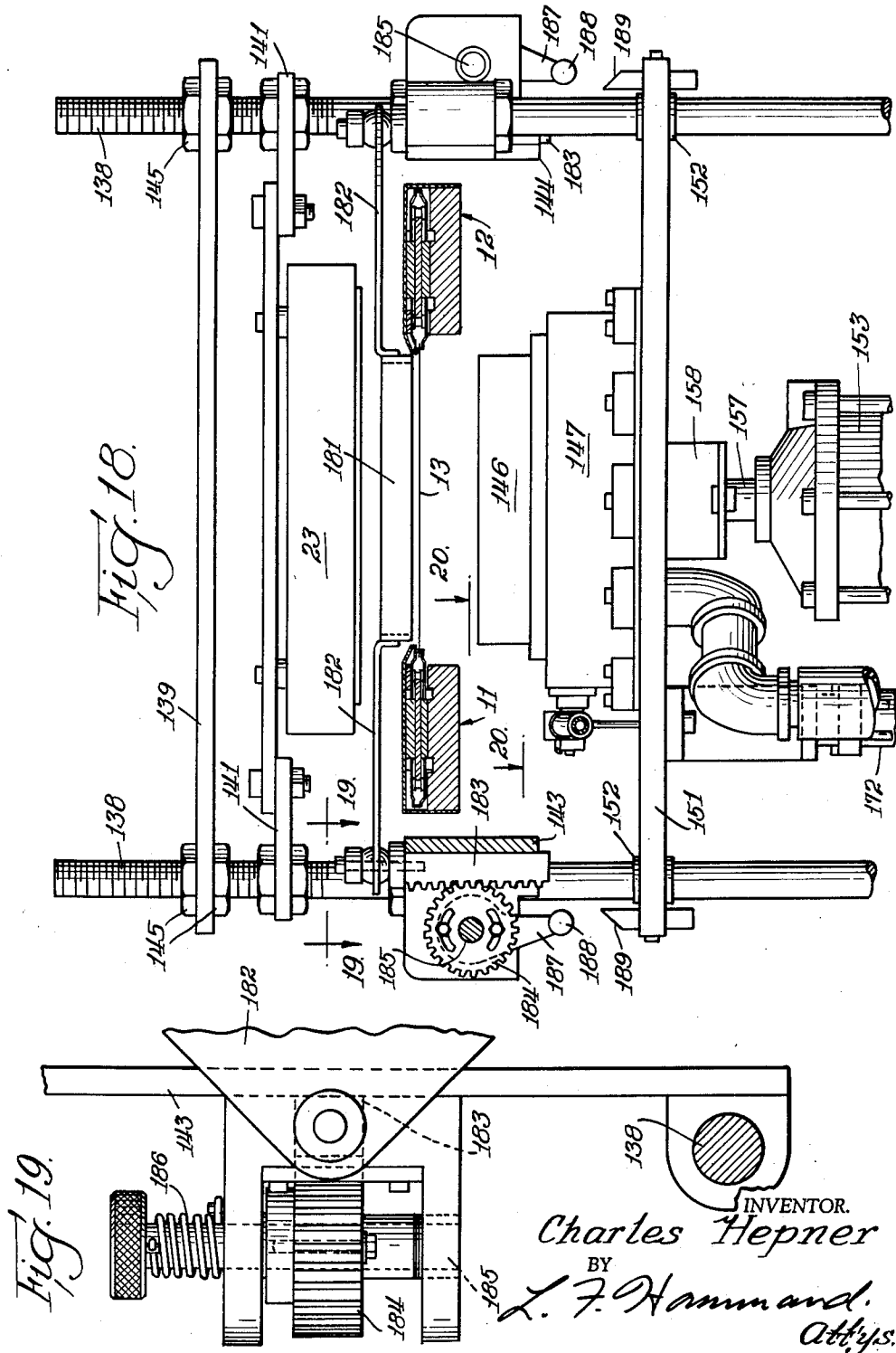
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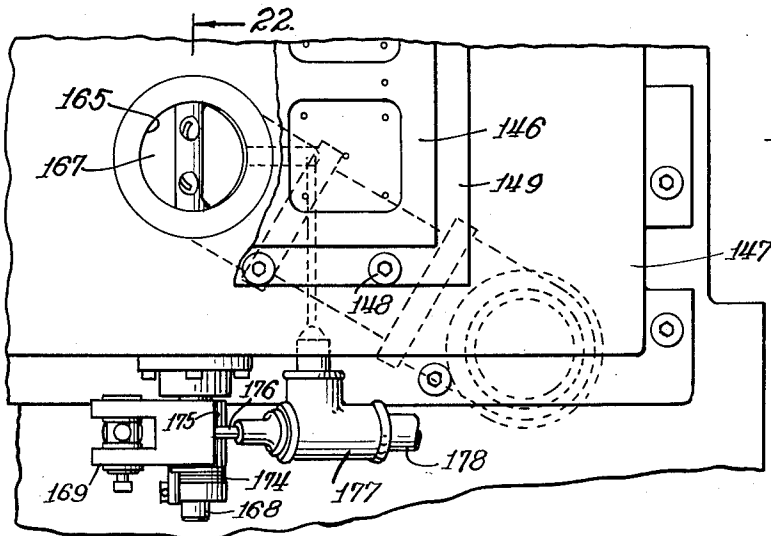


Fig. 20.

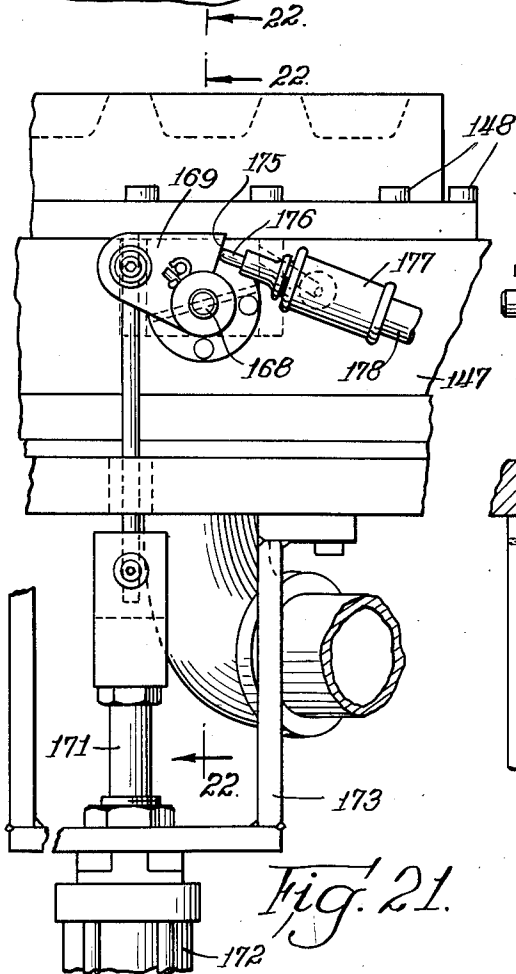


Fig. 21.

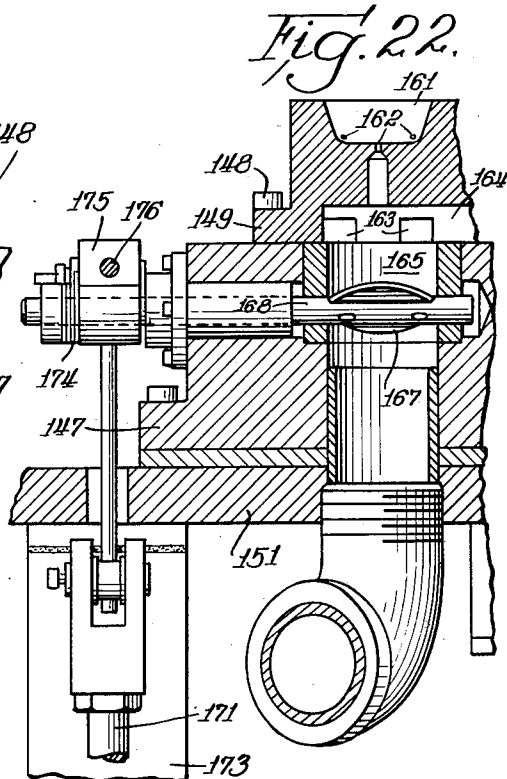


Fig. 22.

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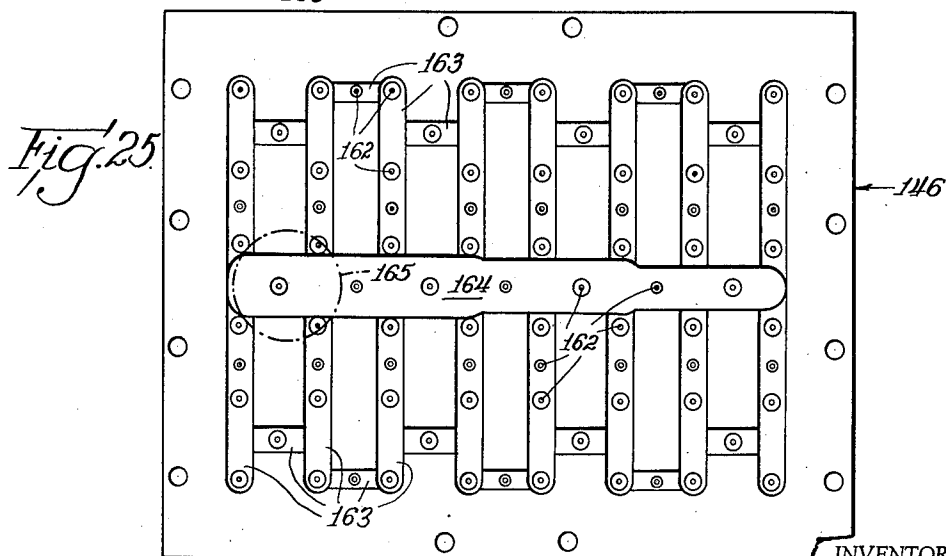
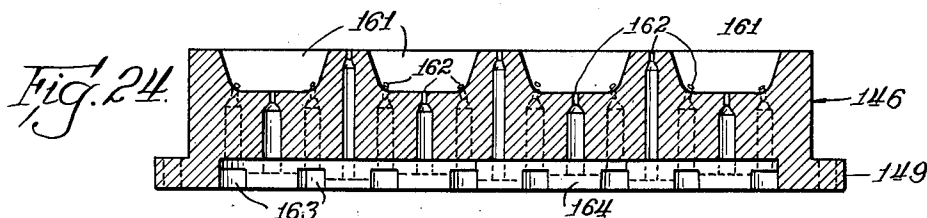
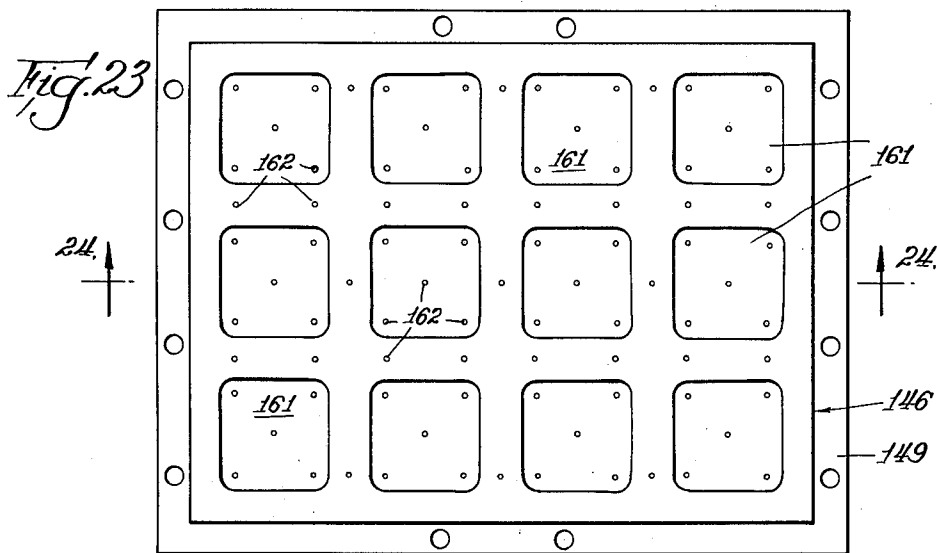
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17 Sheets-Sheet 8



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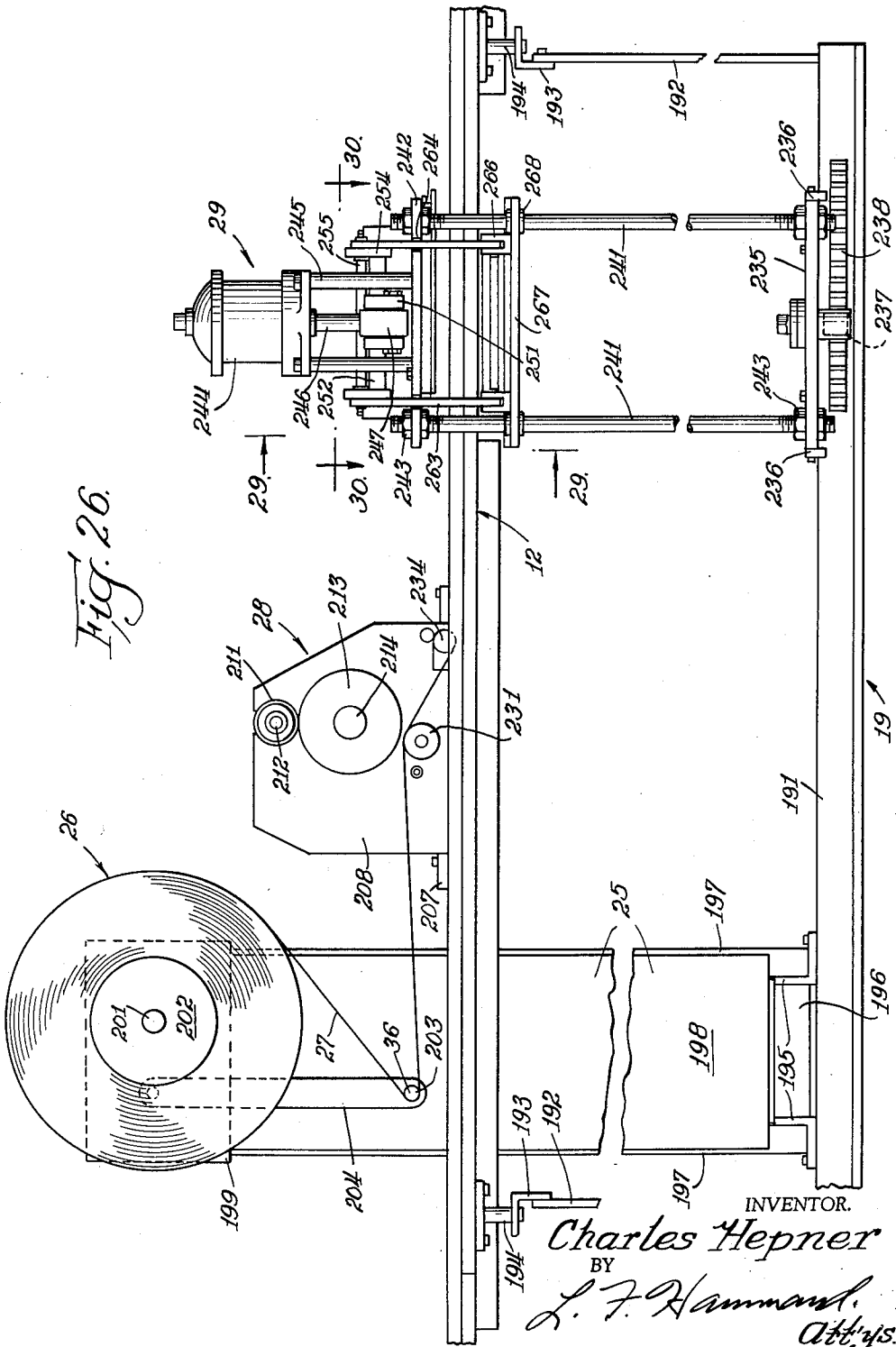
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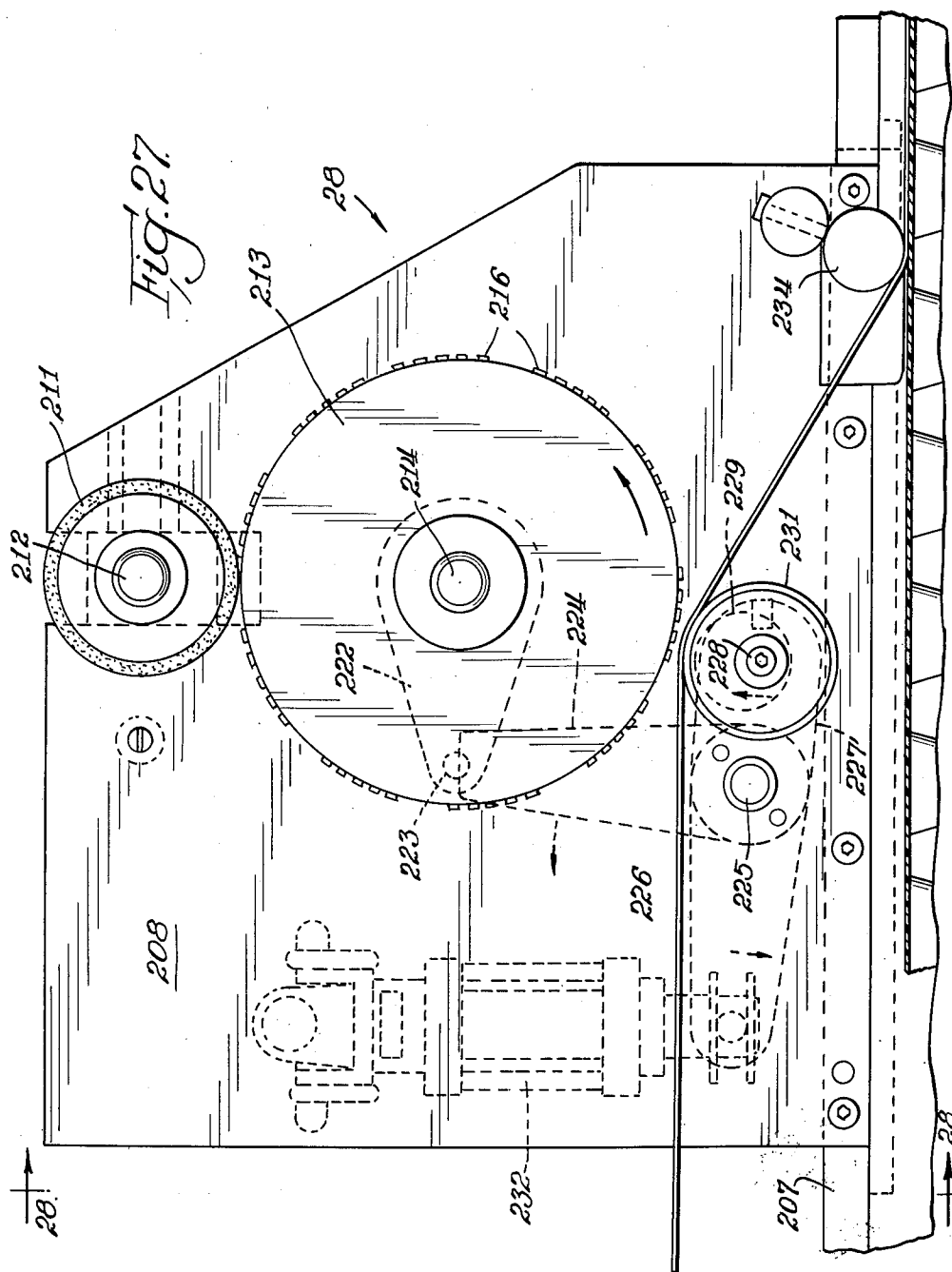
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C. HEPNER
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Filed April 13, 1959

17 Sheets-Sheet 10



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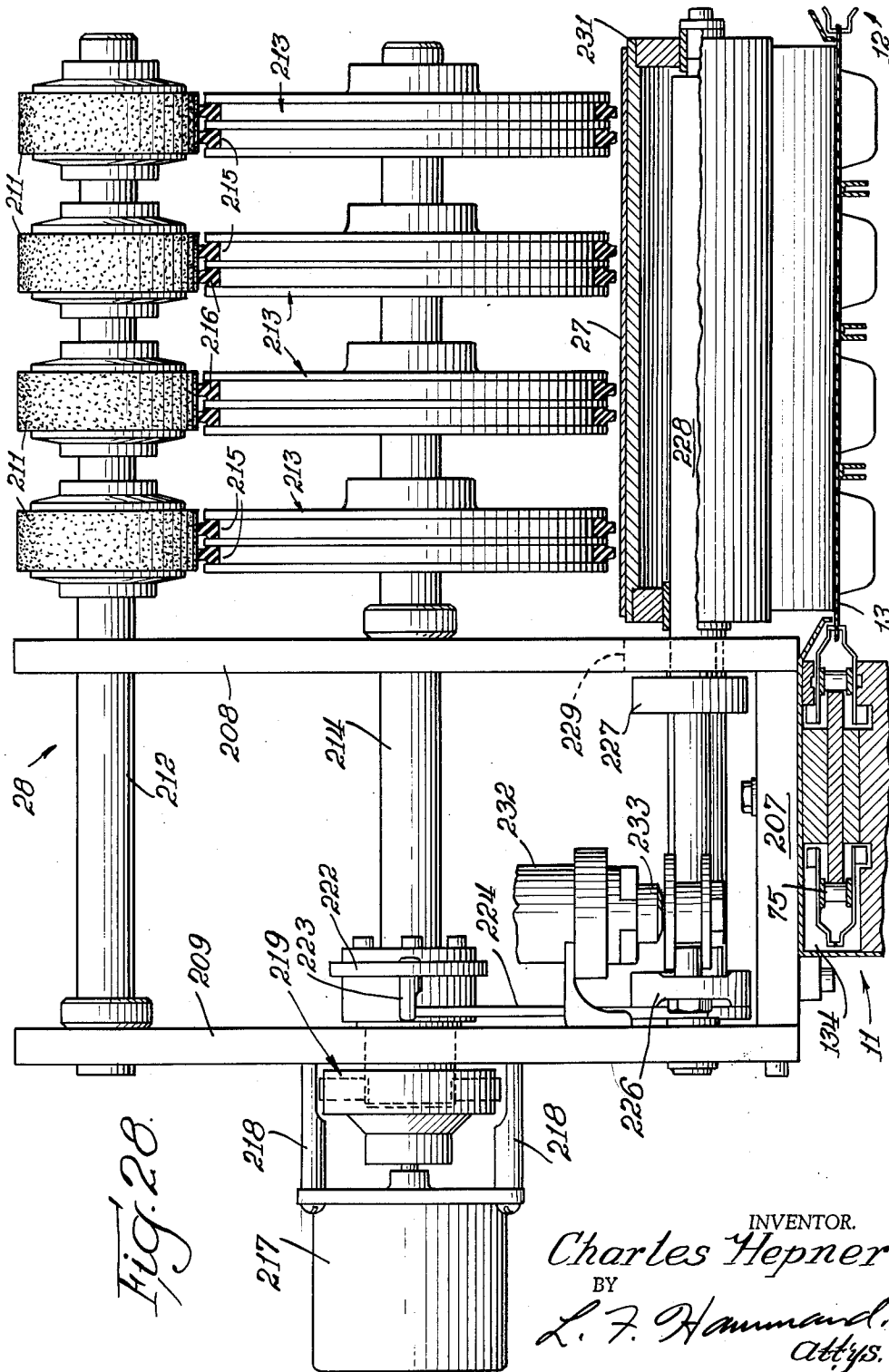
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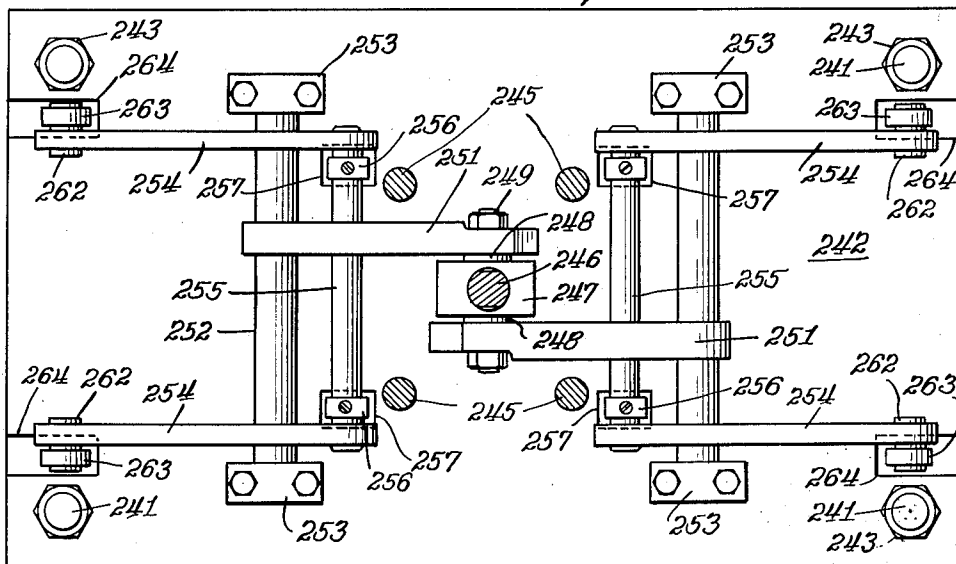
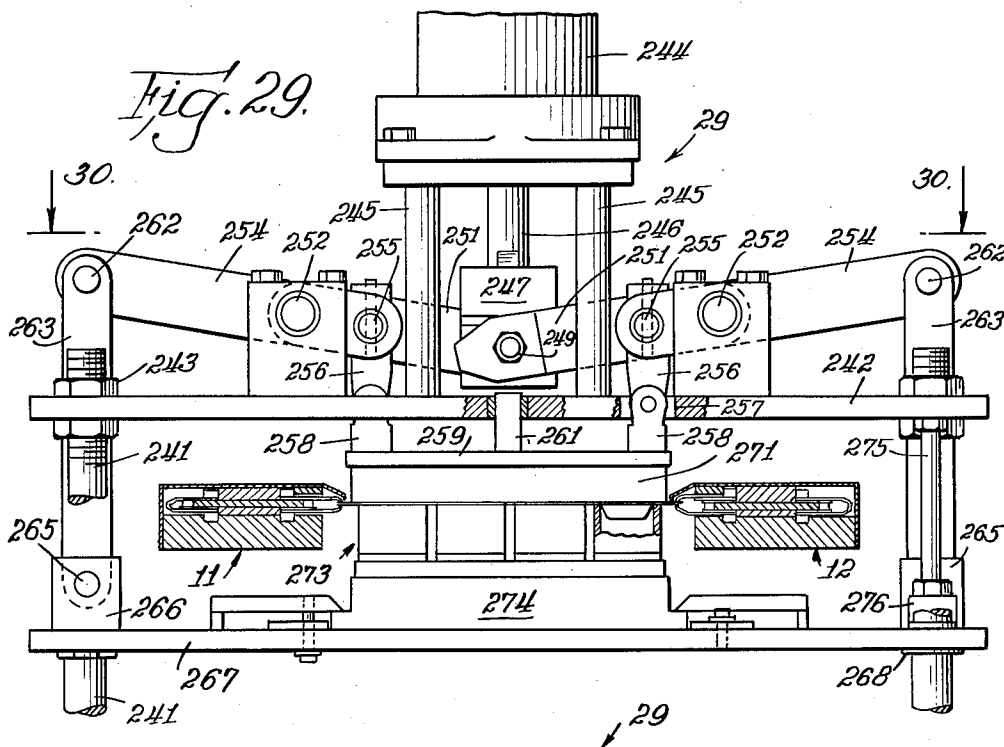


Fig. 30.

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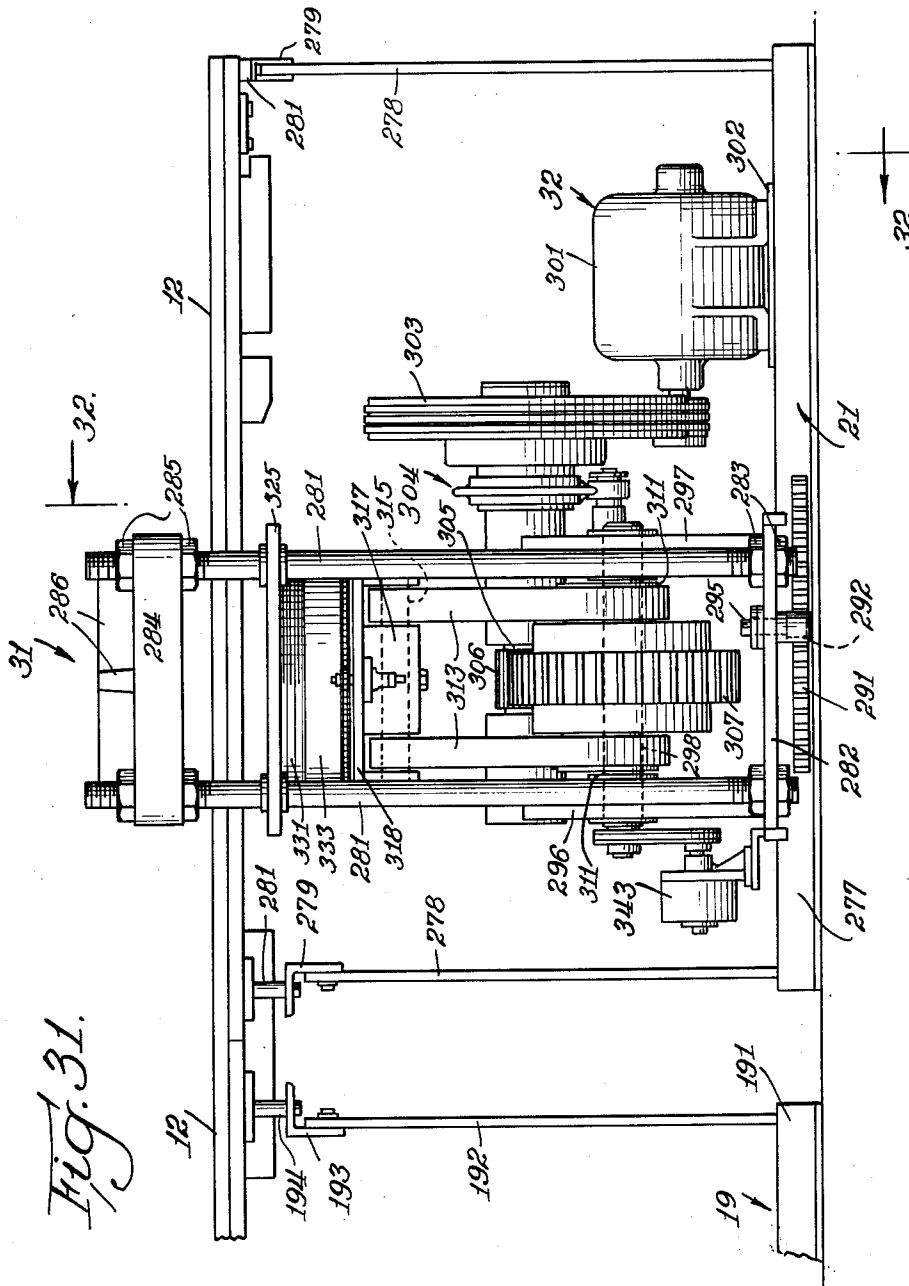
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PACKAGING MACHINE

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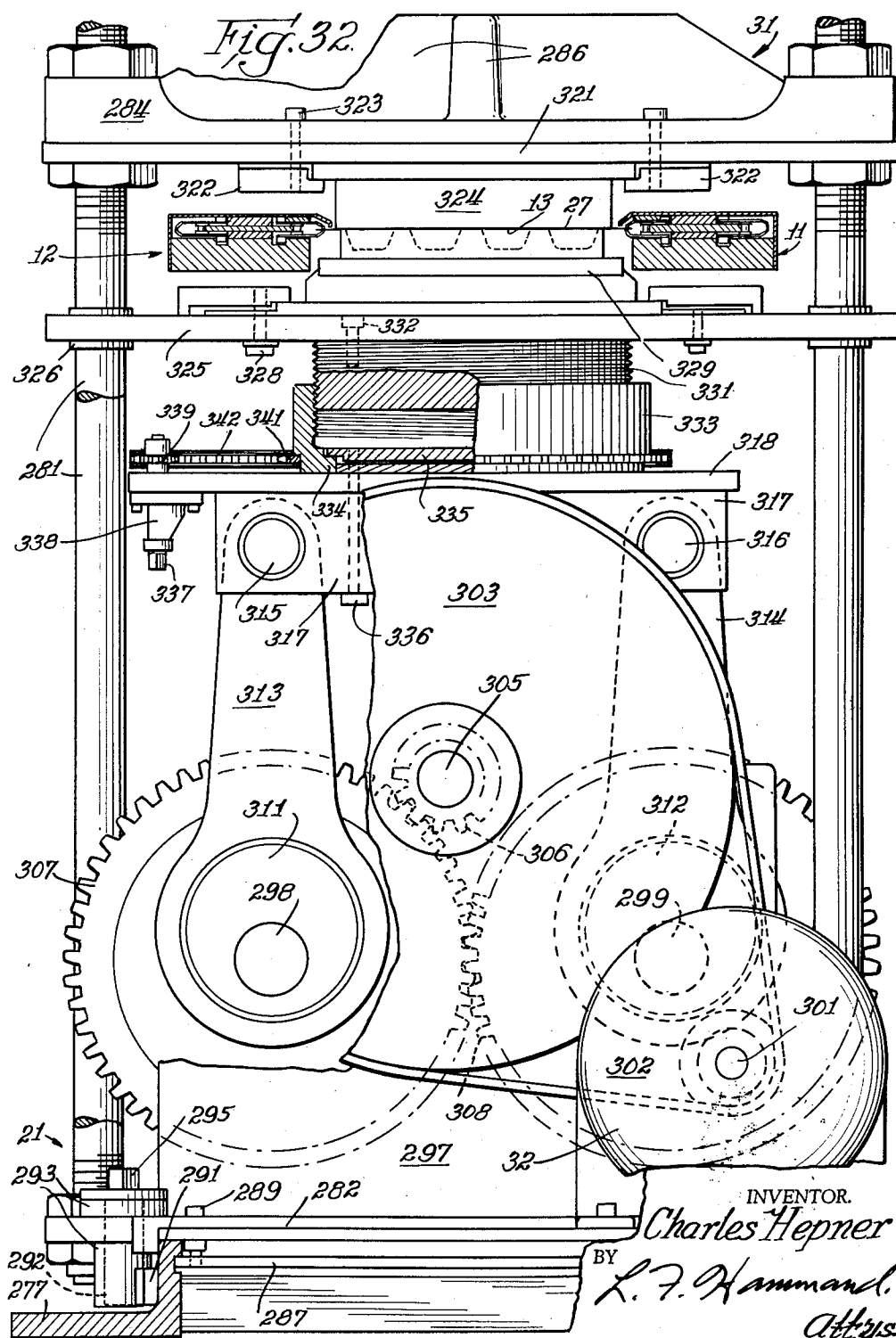
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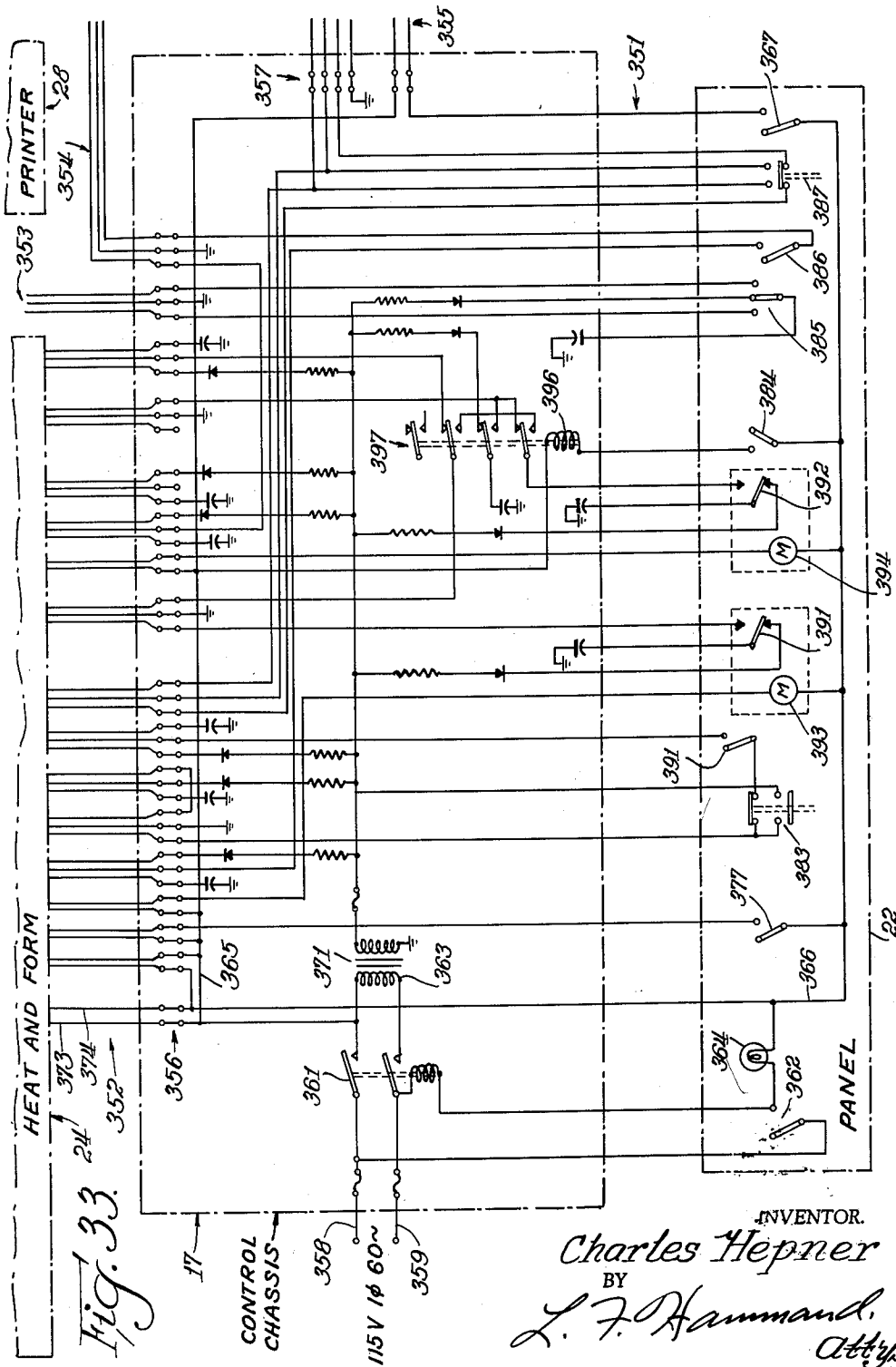
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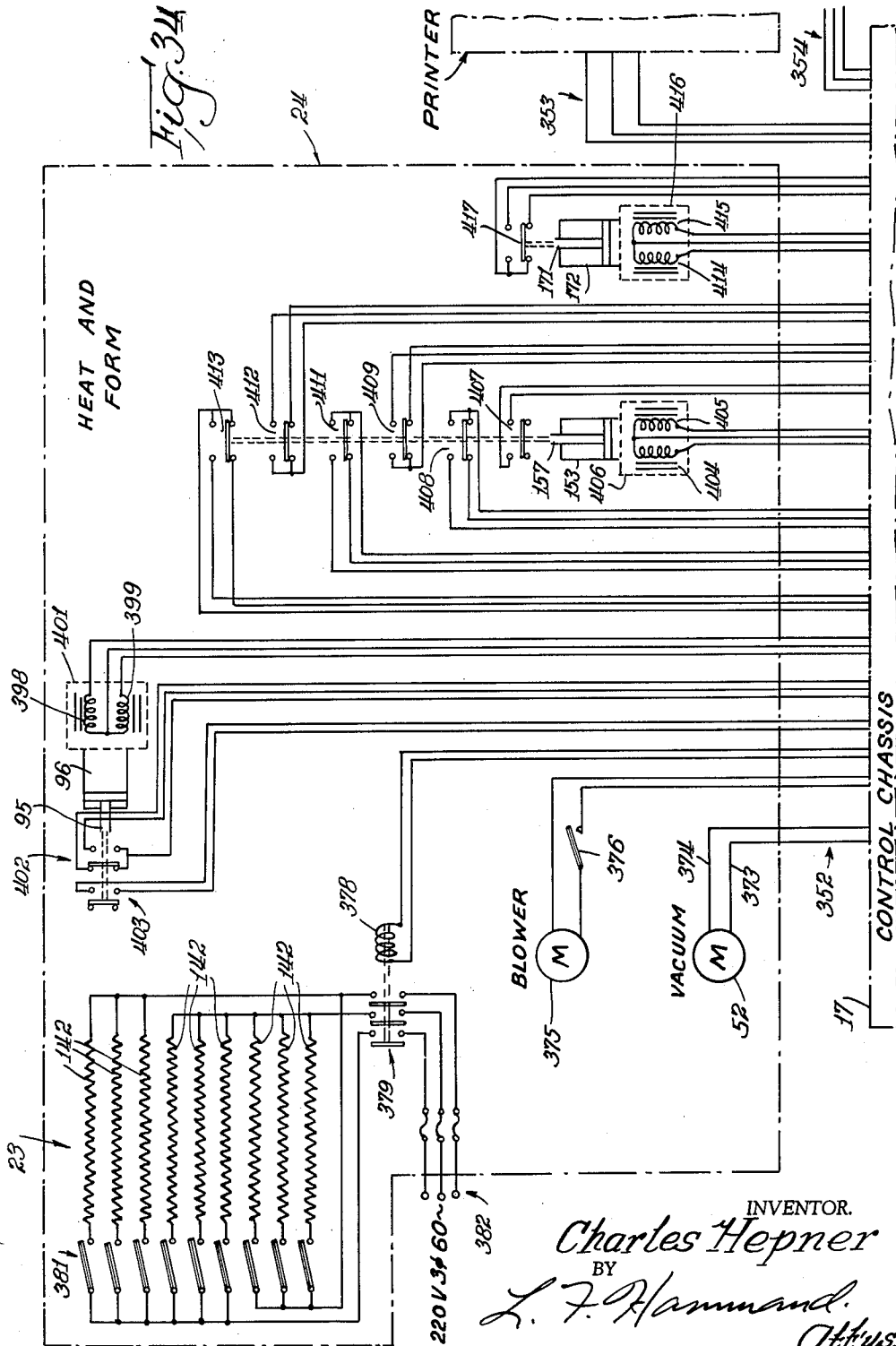
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PACKAGING MACHINE

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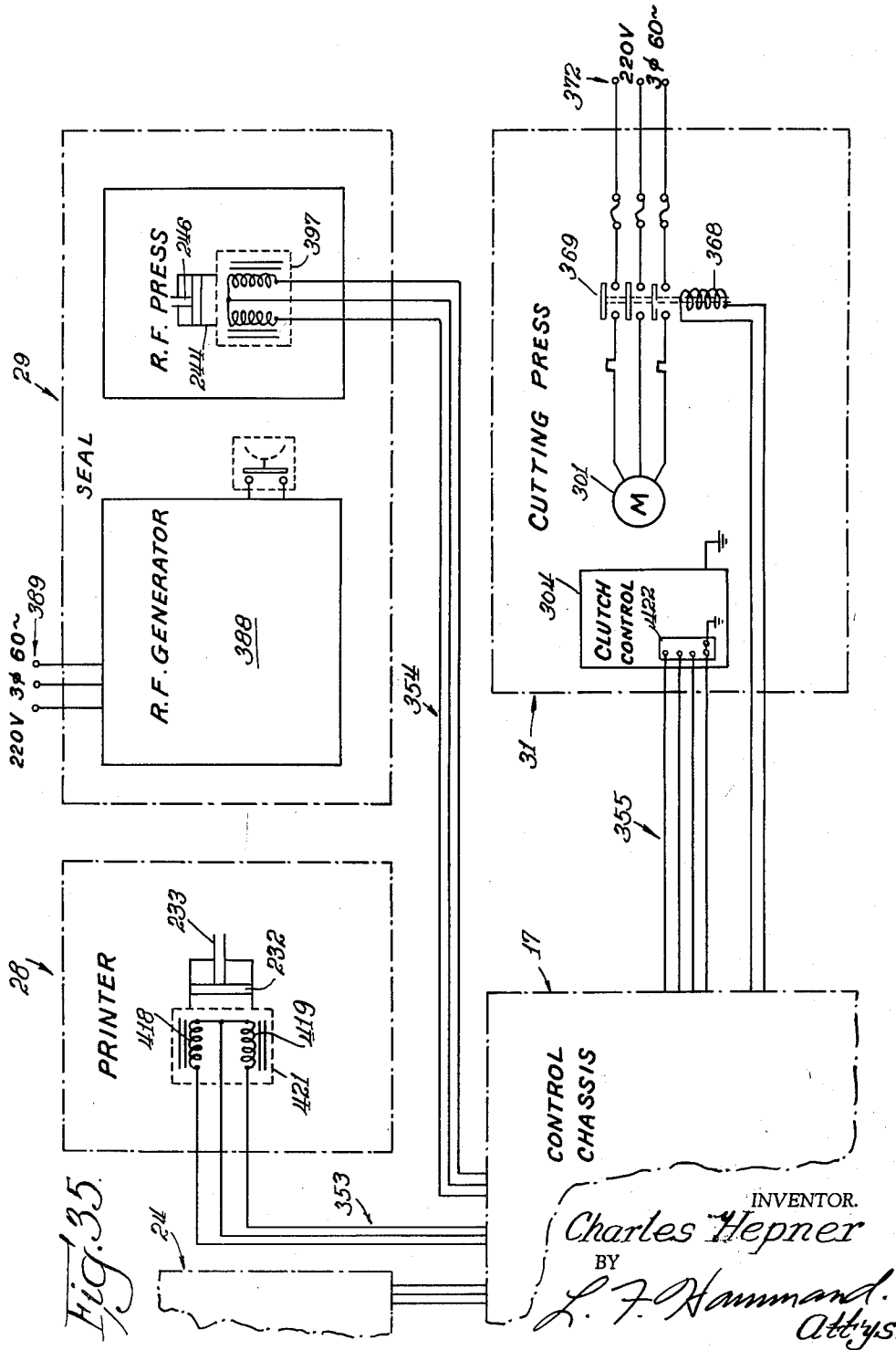
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3,029,007

PACKAGING MACHINE

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Filed Apr. 13, 1959, Ser. No. 805,930

10 Claims. (Cl. 226-173)

This invention relates to packaging machinery and more specifically to automatic machinery designed for the formation of molded packages from transparent sheet plastic web.

It is the general aim of the invention to provide an improved, yet simplified, continuous process packaging machine which is fully automatic in nature and capable of high speed mass production of molded plastic bubble packages, yet which is nevertheless of such flexible mechanical design that it is suited to the production of bubble packages of various sizes and shapes, and formed of various thicknesses and compositions of plastic. A further aim is to accomplish the above results in a machine designed to require a minimum amount of adjustment to handle the various types of plastics and various mold forms as may be required for highest possible productivity.

A further object of the invention is to provide, in combination with a machine having the characteristics outlined above, forming devices adapted to the formation of open-topped package cavities drawn downwardly as pockets in a continuous web of plastic whereby the individual pockets may be exposed for loading while still an integral part of the web sheet, and thereafter closed, labeled and sealed before separation from the web. It has been found that this arrangement avoids unnecessary individual handling of the plastic packages and facilitates loading, either manual or automatic, while at the same time preventing or minimizing any undesirable effects due to the longitudinal and transverse stretching which is inherent in packaging materials of this general nature.

It is also among the objects of the present invention to provide an improved, yet simplified automatic packaging machine and a unique packaging method whereby the forming of the plastic bubble is done by drawing pockets downwardly from a horizontal plastic sheet, with the pockets upright and held in predetermined orientation so that the loading of the pockets may be easily done and the closing, printing and separating of the individual packages accomplished thereafter with maximum speed and with fully automatic control.

A further object of the invention is the provision of a unique form of molding apparatus specifically suited to operation in connection with a continuous plastic web supply wherein the three dimensional package shapes are formed by vacuum drawing the plastic web downwardly from the plane of the web into suitable mold cavities and then ejecting the plastic web from the mold as the mold itself is lowered from the plane of the web. This permits the plastic web to be advanced toward a loading station without interference with the structure of the mold; whereby the individual package forms may conveniently be presented at the loading station in a position accessible for loading with the open tops thereof disposed upwardly.

A still further object of the invention resides in the provision of a unique method of facilitating release and ejection of the plastic web from the mold cavities by providing an air cylinder for raising the mold to the plane of the plastic sheet, and discharging the exhaust air from this cylinder into the mold to eject the plastic web therefrom just before the mold starts to move down, thus insuring synchronization of the operating parts of the mechanism by positively ejecting the plastic from the mold prior to its advancing movement.

Another of the primary objects of the present invention

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is to provide an automatic machine for making and loading plastic bubble packages with a unique and improved organization of the related operating parts of the machine to increase speed of production and facilitate loading of the packages by automatically operated mechanisms or by hand, particularly by the provision of a conveyor adapted to move a sheet of plastic material along a predetermined path in intermittent regular steps, and to carry it through a forming station, a loading station, a printing station, a sealing station and a cutting station, the forming station having molding devices adapted to move toward the opposite faces of the plastic and draw package cavities therefrom, with the loading station arranged to leave the tops of the cavities open to facilitate loading while the package portions remain integral with the web, and the cutting station having means for severing the individual packages from the web after loading and sealing.

A more specific object of the invention is to provide, in an automatic package forming machine including instrumentalities for heating, forming, loading, printing, sealing and separating the packages produced, an improved and unique conveyor adapted to carry a single continuous sheet of plastic web stock through the several operative stations of the machine and to maintain the web in properly supported condition, both longitudinally and transversely, as the various sequential operations are performed, to permit proper registration and synchronization of the mechanism not only during the formation of the package shapes, but also throughout the loading, labeling and sealing operations.

Another important object of the invention resides in the provision of an improved conveying device for an automatic bubble packaging machine consisting of a pair of endless looped chains with each of the chains having its forwardly operating span parallel with and closely adjacent one edge of an elongated sheet of plastic stock and with the rearwardly moving span of each chain remote therefrom, with guide members for the chains loosely surrounding the chain links to limit the lateral free motion of the chains at all points between the sprockets, yet to accomplish this result without lateral force on the chain links and with minimum operating friction.

A further specific object of the invention is the provision of an improved conveyor for moving a plastic web through operating stations spaced substantially apart from each other in a package forming machine, the conveyor providing positive support along both edges of a relatively long length of the plastic and designed to achieve precise registry of the cavities therein in the several operating stations, yet so designed as to be free-running and relatively friction free, even in applications using a conveyor of considerable length.

A still further object of the invention is to provide an improved conveyor designed to support the opposed edges of a continuous length of plastic web stock wherein the conveyor parts are so designed as to operate essentially in the plane of the plastic sheet, whereby the conveyor parts do not project substantially above the upper surfaces of the plastic and thus do not obstruct access to the cavities of the plastic for loading.

A further object of the invention is the provision of an improved conveyor for the sheet stock of a plastic bubble packaging machine, suited to use in connection with a machine assembly of considerable length and adapted to utilize plastic sheets of differing widths and differing thermal characteristics, while at the same time being so designed and constructed to accommodate plastic sheets of widely varying thicknesses without adjustment.

A related object of the invention is the provision of a unique and improved press linkage whereby coacting heat sealing members above and below the plane of the plastic sheet may be simultaneously retracted or advanced to

meet at the precise plane of the plastic sheet and are so arranged that the entire unit may be actuated by a single air cylinder in a manner to accomplish uniform distribution of forces, thus maintaining the paired heat sealing members in substantially perfect parallelism and with equal pressure throughout their operating areas.

The foregoing objects are accomplished in the present invention by an automatic mechanism consisting essentially of a series of processing stations for heating, molding, loading, sealing, labeling and separating the individual plastic packages, together with a conveyor adapted to move the continuous plastic sheet through the various operating instrumentalities yet maintain it in substantially perfect registry and synchronization at all points, notwithstanding the varying characteristics of stretch, shrinkage, warping and sagging encountered with various widths or thickness of sheet stock, and the varying thermal and chemical characteristics of different plastics.

A preferred embodiment of the present invention is illustrated in the drawings attached to and forming a part of the present specification, wherein:

FIGURE 1 is a plan view of the entire machine;

FIGURE 2 is a front elevational view thereof;

FIGURE 3 is a perspective view of a typical transparent bubble package such as produced on the machine;

FIGURE 4 is a top view of the package shown in FIGURE 3, illustrating a typical label such as the machine may print on the package;

FIGURE 5 is a fragmental detail sectional view of a typical forming mold, illustrating the manner of vacuum forming an open topped package cavity in the plastic web;

FIGURE 6 is a sectional view of the plastic web at the loading station, illustrating the manner of loading the individual package cavities;

FIGURE 7 is a fragmental detail sectional view of the printing instrumentalities of the machine whereby the packages are labeled;

FIGURE 8 is a fragmental detail sectional view of one of the package cavities during the sealing operation;

FIGURE 9 is a fragmental detail sectional view of the punch press dies of the machine, showing one type of die contemplated for cutting around the individual loaded packages preparatory to separating the packages from the web; and

FIGURE 10 is a bottom plan view of a completed package, while still attached to the web.

FIGURE 11 is a rear elevational view of the main frame and forming press of the machine;

FIGURE 12 is a detail sectional view taken substantially on the plane of the line 12—12 of FIGURE 13, showing an adjustment of the conveyor track;

FIGURE 13 is a transverse sectional view of the main frame at the intake end of the conveyor, the view being taken substantially on the plane of the line 13—13 of FIGURES 1 and 2 and illustrating the conveyor drive mechanism;

FIGURE 14 is a fragmental detail plan section of one end of the conveyor chain and the drive sprocket associated therewith, the view being taken substantially on the plane of the line 14—14 of FIGURE 13;

FIGURE 15 is a transverse detail sectional view through one of the endless conveyors of the mechanism, the view being taken substantially on the plane of the line 15—15 of FIGURE 14;

FIGURE 16 is a detail sectional view taken substantially on the plane of the line 16—16 of FIGURE 14 and illustrating the manner in which the conveyor engages the edges of the plastic web stock;

FIGURE 17 is a detail fragmental sectional view taken substantially on the plane of the line 17—17 of FIGURE 16;

FIGURE 18 is a transverse sectional view through the machine, at the forming press, the view being taken substantially on the plane of the line 18—18 of FIGURES 1, 2 and 11;

FIGURE 19 is a detail plan sectional view of the mechanism for operating the clamping ring of the vacuum forming mold, the view being taken substantially on the plane of the line 19—19 of FIGURE 18;

FIGURE 20 is a fragmental plan sectional view of the vacuum forming mold, the view being taken substantially on the plane of the line 20—20 of FIGURE 18;

FIGURE 21 is a fragmental rear elevational view of the air and vacuum valves associated with the vacuum forming mold of FIGURE 20;

FIGURE 22 is a fragmental sectional view through the air and vacuum ducts of the forming mold, the view being taken substantially on the plane of the lines 22—22 of FIGURES 20 and 21;

FIGURE 23 is a plan view of a typical twelve cavity package mold for utilization with the machine, and designed for the formation of rectangular packages such as illustrated in FIGURES 3 and 4;

FIGURE 24 is a detail section through the mold illustrated in FIGURE 23 and taken substantially on the line 24—24 thereof;

FIGURE 25 is a bottom plan of the mold shown in FIGURES 23 and 24, illustrating the air and vacuum ducts formed in the underside thereof;

FIGURE 26 is a front elevation of the intermediate frame, showing the closing, labeling and sealing stations of the assembly;

FIGURE 27 is an enlarged front elevational view of the printing press of the machine;

FIGURE 28 is a transverse sectional view taken substantially on the plane of the line 28—28 of FIGURES 26 and 27 showing details of the printing devices;

FIGURE 29 is a transverse sectional view taken substantially on the plane of the lines 29—29 of FIGURES 1, 2 and 26 and showing the linkages employed for advancing and retracting the sealing members to the upper and lower sides of the web; and

FIGURE 30 is a detail plan sectional view of the sealing press linkages taken substantially on the plane of the lines 30—30 of FIGURES 2, 26 and 29.

FIGURE 31 is a front elevational view of the end frame of the machine and illustrating the punch press associated therewith;

FIGURE 32 is a detail sectional view of the punch press operating mechanism, taken on the lines 32—32 of FIGURES 1, 2 and 31; and

FIGURES 33, 34 and 35 are schematic wiring diagrams of the control circuits of the machine.

Before describing the details of structure of the preferred embodiment of the invention illustrated in the drawings, it is believed advisable to review the general organization of the main units of the machine and to outline the operations which they perform. In this connection it may be explained that the machine consists essentially of a series of processing units to form, fill, label and seal the packages, with a long conveyor adapted to feed a continuous strip of sheet plastic material through the individual units, which are synchronized to operate on the plastic of the web as it is advanced.

The conveyor comprises two elongated track assemblies, generally designated as conveyor sections 11 and 12 (FIGURE 1), arranged to grip the opposite edges of a continuous narrow strip 13 of sheet plastic material and thus draw it from a supply reel 14 over idlers 15 and 16 into the intake end of the conveyor. The conveyor then functions to carry the strip of plastic web through the various operating instrumentalities of the assembly and to discharge the web at the opposite end of the machine.

The operating instrumentalities of the assembly are preferably carried on three separate frames, to facilitate dismantling the equipment for shipping. As illustrated, these consist of a main frame member generally designated 17, which extends from the reel 14 to a loading station 18 (FIGURE 1), with an intermediate frame

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19 between the loading station and an end frame 21. The main frame 17 includes mechanism to operate the conveyor assemblies 11 and 12, together with a control panel 22 on which electrical control switches for the unit are preferably mounted, and a preheating unit 23 adapted to heat the plastic sheet and render it pliable as it approaches the forming press 24 of the device. The main frame also serves to house some of the vacuum equipment utilized by the press 24 in the forming operation.

The conveyor tracks 11 and 12 are also preferably made up in sections generally corresponding to the length of the loading station 18 and the frame units 17, 19 and 21, with the several sections each individually supported by the frame therebelow, and with the section extending across the loading station supported between the frames 17 and 19, but it will be understood that the conveyors utilize a common pair of operating chains extending from the intake end to the discharge end thereof so that the several sections, while structurally independent, are normally coupled to each other in alignment and in a manner such that they function as a unitary conveyor extending throughout the entire length of the apparatus.

The intermediate frame of the device, generally designated at 19, includes a side frame 25 to support a feed reel 26 of sheet material 27 (which may be either paper or plastic), for closing and sealing the individual packages manufactured by the machine. The intermediate frame also carries a printing unit 28 for applying appropriate label indicia to the closure sheet 27 and a sealing press 29 for bonding the closure sheet across the tops of the package cavities formed in the plastic web 13, as will appear.

The end frame 21 serves as a mount for a punch press 31 and for its driving motor 32 and, if desired, may also support a take-up reel for scrap web emerging from the machine after the completed packages are severed from the web.

The general mode of operation of the mechanism involves:

- (a) Drawing a continuous strip of the sheet plastic web 13 from the reel 14 in step-by-step motion, with the length of the steps corresponding to the size of the particular die being used in the forming press 24, so that the precise length of plastic required for the forming mold will be supplied to it for each operation;
- (b) Preheating the plastic by passing it under electrical heating units 33 supported above the main frame in a zone through which the web feed passes before entering the forming press 24;
- (c) Subjecting the web to a vacuum forming operation in the press 24, to stretch the plastic downwardly from the plane of the sheet into one or more mold cavities, thus molding a number of open-topped plastic pockets, package cavities, or "bubbles" in the sheet;
- (d) Advancing the plastic web (with the package cavities held in predetermined spacing and orientation therein) in step-by-step manner across the loading station 18;
- (e) Filling the open-topped plastic bubbles with the material to be packaged (either by hand or by automatic feeding instrumentalities diagrammatically illustrated at 34) as the web is carried across the loading station;
- (f) Feeding a length of the closure sheet 27 from supply reel 26 across a straightening idler 36 to a position immediately above the open-topped bubbles in the web;
- (g) Applying appropriate indicia to the closure sheet by the printing press 28 of the intermediate frame 19;
- (h) Bonding the closure sheet 27 to the web 13 around each of the package cavities formed therein to provide an individual sealed capsule surrounding each of the pieces of merchandise inserted in the pockets during the loading operation;

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- (i) Feeding the laminated web, consisting of sheets 13 and 27 into the punch press 31 to die-cut the web around each of the individual plastic bubble package units (yet without completely severing the web), thus leaving the packages attached to the web by frangible tabs or fibres; then
- (j) Advancing the web to carry the cut packages from the punch press 31; and then
- (k) Severing the individual packages from the web as the web is ejected from the discharge end of the conveyor, as by bending the web abruptly over the edge of a cutting bar or knife.

This sequence of operations is illustrated in FIGURES 5 to 10, inclusive, wherein FIGURE 5 shows the plastic web being drawn into the cavity of the forming die by vacuum; FIGURE 6 shows the manner of supporting the open-topped bubbles by the plastic web in the loading station; FIGURE 7 illustrates the printing operation; FIGURE 8 shows the sealing press bonding the closure sheet onto the upper surface of the plastic web; FIGURE 9 shows the operation of the cutting dies of the punch press, and FIGURE 10 shows the filled packages cut from the laminated web but still loosely secured thereto by the interconnecting fibres around the edges of the individual packages. FIGURES 3 and 4 show one of the individual packages after being severed from the web.

The Main Frame

The main frame of the assembly includes a pair of longitudinally extending angle irons 41 having their vertical flanges spaced apart from each other by appropriate transverse braces 42 and their horizontal flanges extending outwardly from each other and perforated at intervals for bolting to a floor surface. The frame includes four angle iron uprights with the pair of uprights 43 adjacent the end of the machine interconnected by a flat cross bar 44 and the uprights 45 adjacent the forming unit interconnected by a similar cross bar 46. The uprights are also interconnected by longitudinal beams 47 and 48. The forward ends of each of these longitudinal members are secured to the uprights 45. The rear end of the beam 47 is secured to a horizontal plate 49 on the front face of the cross bar 44, and the member 48 secured directly to the upright 43 on the other side of the machine. The forward and rear surfaces of the rectangular frame thus formed are enclosed by removable sheet metal panels 51 mounted in a manner to provide easy access to the enclosed portions of the mechanism, within which a vacuum pump 52 and vacuum tank 53 are mounted.

The Plastic Web Supply

It is contemplated that a continuous strip plastic web of appropriate width and thickness will be supplied to the machine in a manner whereby the web may be automatically drawn from a supply reel as the conveyor advances it through the mechanism. The machine is accordingly provided with a reel supporting shaft 54 having a pair of tapered hub blocks 55, removably secured on the shaft to hold the supply reel 14 in the conventional manner. The shaft itself is supported by a pair of outboard mounting plates 56 and 57, both on the same side of the reel 14 (FIGURE 1), whereby the front end of the reel shaft 54 is unobstructed, in order that the reel may be replaced merely by removing the forward hub plug 55 from the shaft, and slipping the reel into place. In order to provide suitable operating tension for the web as it is drawn from the supply reel, an adjustable "drag" including a brake band 58 is mounted between the outboard supporting brackets 56, 57 with a brake drum 59 affixed to the reel shaft 54 to supply appropriate resistance to rotation. The entire reel assembly is conveniently mounted on a floor plate 61 secured to the upper surfaces of rearwardly extending portions of the angle irons 41 of the main frame 17, and a swinging support arm 62 is employed to support the idler 15 heretofore mentioned.

The Conveyor

The conveyor, best shown in FIGURES 11 to 17, inclusive, includes a fixed conveyor track assembly heretofore generally designated 11, with a second conveyor track 12 generally parallel with the track 11 but adjustable with respect to it, to permit the utilization of plastic web 13 of any width required for the purpose of the individual shapes to be molded.

The fixed conveyor track 11 has its rearward end mounted on a pedestal 64 carried by the horizontal frame plate 49 which, as heretofore described, is secured to the cross bar 44 at the upper ends of the vertical uprights 43. The adjustable track 12 is similarly mounted on a pedestal 65 carried by a base plate 66 which is, however, secured to the cross bar 44 by paired cap screws 67 operating in a slot 68 (FIGURE 13) to afford adjustment for various widths of the web 13.

The conveyor tracks 11 and 12 both extend the full length of the machine and thus project forwardly from the main frame 17 through the forming press 24, loading station 18, printing unit 28, sealing press 29, and through the punch press 31 to the remote end of the end frame 21. While these track assemblies each function as a continuous unit, they are nevertheless constructed in end-to-end sections whereby they may be severed at the opposite ends of the loading station and between the intermediate frame and end frame to facilitate dismantling the machine for shipping. To this end, the tracks 11 and 12 each may be provided with connecting fittings (shown diagrammatically at 69, FIGURE 2) by which the individual sections are united with each other.

The fixed track 11 of the conveyor is mounted on a series of supporting members in the several frame units of the machine. These supports, as exemplified by the support block 71 of the main frame (FIGURE 13), are permanently secured in fixed positions on the frames. The adjustable conveyor track 12 is similarly mounted except that it is arranged for lateral adjustment. To this end, it is carried on a series of support blocks exemplified by the block 72 of FIGURE 12, which is adjustable across the cross bar 46, and is provided with a clamping plate 73 and cap screws 74 (FIGURES 12 and 13), to hold it in any desired position of adjustment.

The conveyor tracks 11 and 12 each serve to mount and guide one of the endless chain loops 75 of the conveyor. These two chains extend from paired drive sprockets 16 at the inlet end of the conveyor to similarly paired idler sprockets 77 at the discharge end (FIGURE 1). The drive sprockets 76 (FIGURE 13) are simultaneously driven in opposite directions of rotation by a pair of vertical stub shafts 78 journaled in the pedestals 64 and 65, respectively, and having miter gears 81 and 82 affixed to their lower ends in mesh with a pair of miter gears 83 and 84 carried by a transverse drive shaft 85. The shaft 85 is journaled in bearing blocks 86 and 87 depending from the undersurfaces of frame plates 49 and 66, respectively, and has a keyway 89 by which it is slidably coupled to the miter gear 84 to accommodate adjustment of the track 12.

On the rear side of the machine, the drive shaft 85 extends into a gear housing 91 which includes a driving pinion 92 coupled to the drive shaft by an overrunning clutch 93. The pinion 92 is, in turn, arranged to be driven by a reciprocating rack 94 having one end slidably extending through the gear housing and the other end coupled to the piston shaft 95 of an air cylinder 96 which supplies the force for operation of the conveyor. The air cylinder 96 is automatically actuated by solenoid valves illustrated in connection with the control circuits of the machine, and is provided with an adjustable limit stop 97 consisting of a bracket fitted over the teeth of the rack and held in place by a cap screw. By adjusting the limit stop along the rack 94, the length of the stroke of the piston and rack may be set to the precise length of feed desired for any individual mold being

utilized by the machine. The piston shaft 95 of the cylinder also actuates other control devices of the mechanism, as shown in the circuit diagrams of FIGURES 33, 34 and 35.

The conveyor track assemblies 11 and 12 each consist of a chain guide plate 101 mounted on a supporting beam 102 and spaced above it by a spacer 103 (FIGURE 15). A second spacer 104 is positioned above the chain guide plate to receive and support a sheet metal cover 105, which has a downwardly extending outside flange 106 bearing against the beam 102 on the side away from the web, and an inner flange 107 overlying an adjacent edge of the web strip 13 in closely spaced relation thereto. The cover 105 has a guide strip 108 mounted on its underside, and the beam 102 and guide strip are grooved to form guide channels 111, 112, 113 and 114 of sufficient size to provide adequate clearance around the chains yet guide them along the tracks as heretofore described. This results in a chain guide construction wherein the path of movement of the chain is closely confined, yet wherein there is enough clearance on all sides of the chain links so that the chain may operate quite freely, even in a machine employing a relatively long conveyor assembly. The chains 75 utilized with the conveyor have their alternate links provided with pairs of inwardly extending brackets 115 and 116, each carrying one of the small rectangular slide blocks 117 and 118 riveted to the upper and lower faces of the links and slidable in the channels 113 and 114 heretofore described. The upper and lower faces of the chain brackets 115 and 116 also carry spring fingers 121 and 122, each of which have their free end portions disposed across the chain and inwardly offset towards each other to provide opposed tapered cam surfaces 123 and 124 terminating in jaw portions 125 and 126 having alternately disposed teeth 127 and 128 (FIGURE 17).

The conveyor chains are simultaneously driven by the transverse shaft 85 previously described, which operates through miter gears 83 and 84 to rotate the mating miter gears 81 and 82 on the lower ends of the vertical stub shafts 78, which extend through the pedestals and carry the driving sprockets 76 of both of the conveyors. These sprockets, best shown in FIGURES 14 and 16, are provided with elongated tapered teeth 131 which extend between the rollers of the chain, so that when any given portions of the chain are in engagement on the sprocket, the tapered wedge-shaped ends of the teeth project sufficiently beyond the chain rollers to engage the inwardly tapered cam portions 123 and 124 of the gripper fingers and force them apart (FIGURE 16). Thus, as the conveyor chain passes around the drive sprockets, the jaws 125 and 126 are separated sufficiently to provide considerable clearance above and below the plastic web 13. The plastic web 13 is guided into the conveyor and between the jaws of the gripper fingers thereof by feeding the web between a pair of relatively thin guide plates 132 and 133 (FIGURE 11) mounted in superposed position on the extreme ends of the beam 102 of each conveyor track, and spaced apart from each other only enough to provide adequate clearance for the maximum thickness of plastic sheet contemplated for use in the machine. Thus, as the edges of the plastic web enter the conveyor, they pass between the spaced jaws of the gripper fingers (FIGURE 16), but as the chains continue to move forward, the withdrawal of the sprocket teeth 131 from the inner cam surfaces 123 and 124 of the fingers permits the inherent spring tension of the fingers to cause them to close on the plastic, whereby the jaws will grip the opposite edges of the plastic firmly and positively at closely spaced intervals (FIGURE 14). By this expedient, the plastic sheet may be carried the entire length of the machine with adequate support, thus avoiding problems due to uncontrolled shrinkage, stretching or sagging of the plastic, yet in a manner to maintain each incremental length of the plastic in properly spaced

relation at all times so that package cavities formed in the plastic sheet near one end of the conveyor may be fed through subsequent loading, sealing and cutting operations in perfect synchronism and in accurate registry with the dies of all processing stations.

As the conveyor chains reach the extreme end of the machine, they pass around the idler sprockets 77 on the end frame of the assembly, so that the return span of each of the chains moves through a covered channel 134 under the corner of the covers 105 of each of the conveyor tracks. The idler sprockets 77 have teeth similar to the teeth 131 of the drive sprockets, and these open the conveyor jaws 125 and 126 as the discharge end of the conveyor is reached.

The Forming Press

The forming press 24 is positioned immediately adjacent the main frame, with its horizontal base plate 137 secured directly on extensions of the longitudinal angle irons 41 (FIGURE 1).

The frame of the forming press consists essentially of four corner members comprising two pairs of vertical tie rods 138 interconnecting the base plate 137 with a top plate 139. The tie rods 138 also carry paired brackets 141 immediately below the top plate to provide a mounting for the preheating frame 23 on which a series of electrical resistance units 142 are arranged to preheat the plastic before the molding operation takes place. A pair of cross frames 143 and 144 are also mounted on the pairs of rods 138 at the front and back of the press, respectively (FIGURE 18). The parts 137, 139, 141, 144 and 143 are all locked in position on the tie rods 138 by nuts 145.

The mold 146, in which the plastic package shapes are formed, is mounted on a platen 147 by cap screws 148 extending through the flanges 149 and the platen is in turn mounted on a lift plate 151, perforated at its four corners and provided with appropriate slide bushings 152 for vertical movement on the upright shafts 138.

The lift plate 151, platen 147 and mold 146 are raised and lowered by a master air cylinder 153 mounted on spaced posts 154 (FIGURE 11) on the upper face of an undercarriage 155, which consists of a flat plate adjustably secured on the upright tie rods 138 by lock nuts 156. The air cylinder 153 is provided with a double-ended piston shaft 157, the upper end of which is threaded into a block 158 on the underside of the lift plate and the lower end of which is provided with a threaded extension passing through the plate 155 and provided with a pair of adjustable stop discs 159 having lock nuts to effect a precise adjustment of the length of stroke of the cylinder. The cylinder is also provided with electrical contactors, shown in the diagrammatic illustration of the control instrumentalities of the device, to open and close certain electrical circuits of the control system in accordance with the position of the piston shaft 157. The platen 147 thus supplies a vertically shiftable mounting whereby the vacuum forming mold 146 is arranged to be raised to the plane of the plastic web 13 between the conveyor tracks 11 and 12 (FIGURE 18) as the molding operation is about to take place, and to be lowered far enough away from the plastic to clear the molded shapes projecting downwardly therefrom as the plastic is moved forward by the indexing operation of the conveyors.

A typical mold is illustrated in FIGURES 23 to 25. As shown, the mold is designed for the production of packages of the general shape and contour shown in FIGURES 2 and 3, and it is accordingly provided on its upper operating face with a plurality of cavities 161. The upper face of the mold, including the inner walls of the cavities formed therein, are provided with a plurality of drilled air exhaust apertures 162 extending to air channels 163 milled in the underside of the piece to permit air to be exhausted from the mold cavities as the molding operation takes place. Thus, the several exhaust ports 162 intercon-

nect into cross headers 163 and a main header 164 which is connected to a vertical duct 165 extending through the platen (FIGURE 18), and thence to the vacuum tank 53 by a flexible hose 166.

5 A butterfly valve 167 is mounted in the vertical portion of the duct 165 to close the channel in response to rocking motion of the valve rod 168. The valve rod 168 extends from the rear face of the platen 147 and is provided with a short crank arm 169 interconnected to the piston shaft 171 of a small air cylinder 172 which is in turn mounted on the underside of the lift plate 151 by an appropriate bracket 173.

10 A coil spring 174 on the rod 168 allows it to rock slightly beyond the closed position of the butterfly valve 167 so that the step 175 on the crank arm 169 will strike the plunger 176 and open the compressed air valve 177 which is connected to the air outlet of the lower end of the cylinder 153. Thus, as the cylinder 153 discharges prior to lowering the mold, the mechanism is adapted to deliver a monetary blast of compressed air through the supply line 178 and valve 177, and thence into the air passage of the molding die. The arrangement is such that on the up-stroke of the air cylinder 172 the butterfly valve 167 closes the connection to the vacuum tank just before the air cylinder reaches the upper limit of its stroke and further movement of the air cylinder operates the compressed air ejection valve 177 while maintaining the butterfly valve closed under light spring tension.

15 The forming station thus includes a vacuum forming mold adapted to be raised to the level of the undersurface of the plastic sheet 13 with each molding operation. This mold coacts with a clamping ring 181 which, as illustrated, is of rectangular form and of a size to fit around the margin of the upper face of the mold, in a manner to clamp the edges of the plastic sheet against the mold during the vacuum forming operation. It is also desirable that this clamping ring 181 be raised above the level of the plastic during the movement of the conveyor and to this end the clamping ring 181 is carried on a pair of laterally extending brackets 182 each affixed to a ball mounting pivot on one of the cross frames 143 (FIGURE 18). In order to raise and lower the clamping rings 181, the pivots 182 are each secured to the upper end of a rack member 183, slidably mounted in one of the cross frames 143, 144.

20 As best shown in FIGURES 18 and 19, the vertical rack members 183 are in engagement with paired pinions 184 each carried by a stub shaft 185 having a coil spring 186 tending to lift the racks and the clamping ring. The shafts 185 also include short crank arms 187, which may be adjustable with respect to the pinions, and which carry rollers 188 arranged to be engaged by a pair of wedge cams 189 as the lift plate 151 is elevated. Thus, whenever the lift plate moves upwardly sufficiently to bring the lower surface of the mold into proximity with the underface of the plastic web, the cams 189 strike the rollers 188 and rock the arms 187 outwardly, drawing the racks 183 downwardly and bringing the clamping ring and mold into simultaneous contact with the plastic.

The Intermediate Frame

25 The intermediate frame assembly, generally designated as 19, includes a pair of longitudinally extending angle irons 191 with upright members 192 at each end interconnecting with transverse angle irons 193 and supporting pieces 194 to provide a mounting for the conveyor tracks 11 and 12 heretofore described. The intermediate frame also serves as a support for the side frame 25, the printing unit 28 and the sealing press 29. The arrangement is best illustrated in FIGURES 1 and 26 of the drawings which show the base of the side frame consisting of paired angle irons 195 extending across the upright flanges of the angle irons 191 of the intermediate frame, with spacing members 196 welded between their uppermost flanges. The vertical portion of the side frame consists of a pair of channel members 197 welded to the transverse angles

195 and extending upwardly to a point above the conveyor, with sheet metal closure plates 198 fastened on the inner and outer flanges of the channels to provide a vertical beam of rectangular cross section. The upper ends of the frame beams terminate in a bearing box 199 through which a reel shaft 201 extends. The shaft 201 is journaled in front and back plates of the box 199 so that its front end extends over the conveyor, where it is provided with a pair of tapered roll supporting hubs 202 to hold the supply reel 26. Rotation of the shaft 201 and the reel 26 is resisted by a spring-urged brake acting on a drum within the box 199, as heretofore described in connection with the plastic web supply reel 14, and a straightening idler 203 is fixed to a swinging arm 204, mounted within the bearing box 199 of the frame.

The Printing Unit

The printing instrumentalities of the machine comprise an automatic press arranged to imprint any desired indicia or legend on the upper side of the closure sheet stock 27 so that the individual packages may be appropriately labeled as shown, for example, in FIGURE 4.

The printing unit is mounted on an outboard frame consisting of a base plate 207 bolted to the conveyor track 11 (FIGURE 28), and provided with a forward frame plate 208 and a rear frame plate 209 spaced apart from each other and of the configuration best shown in FIGURE 27. The press includes a series of resilient ink rollers 211 adjustably mounted along a shaft 212 extending between the plates 208 and 209, and projecting forwardly therefrom over the position of the plastic web between the conveyor tracks. The ink rollers 211 run against a corresponding series of printing wheels 213, also individually adjustable along the length of a rotary shaft 214 journaled in suitable bearings in the plates 208 and 209, and provided with peripheral channels 215 to receive interchangeable printing type 216. The shaft 212 is rotatably driven by a motor 217 mounted on spacer posts 218 on the rear face of the plate 208 and the motor is coupled to the shaft 212 through a slip clutch 219.

A crank arm 222 is affixed to the shaft 212 just inside the rear frame plate 209 and the extreme end of the arm has a stop pin 223 projecting rearwardly therefrom in a position to engage a stop lever 224 rockably mounted on a pivot shaft 225 extending between the plates 208 and 209. The stop lever 224 is fastened to a pair of operating arms 226, 227 (FIGURE 28) also pivoted on the shaft 225 and interconnected by an outwardly projecting shaft 228, which extends therefrom through a clearance hole 229 in the forward frame plate 208 so that it may shiftably support a pressure roller 231 in a position directly below the printing wheels 213 heretofore described. An air cylinder 232 is mounted on the inside face of plate 209, and a collar on its piston rod 233 is coupled to the arm 226 to raise and lower the pressure roller 231.

The closure sheet 27 from the reel 26 is drawn over the idler 203 on the arm 204, and thence through the printing press 28, where it passes between the pressure roller 231 and the printing wheels 213 as the imprint (FIGURE 4) is applied. It is then drawn downwardly under an adjustable guide roller 234 positioned directly above the operating plane of the conveyor to bring the closure sheet in substantially surface-to-surface contact with the upper surface of the web.

In the operation of the printing unit, the motor 217 normally tends to drive the printing wheels 213 in the forwardly direction indicated by the arrow in FIGURE 27, but this motion is restrained by the stop lever 224 when the plastic web and conveyor are not in motion. When the air cylinder 96 on the main frame is actuated to move the conveyor forward, however, the air cylinder 232 on the printing unit is also caused to operate in a manner to force its piston rod 233 downwardly, thus rocking arms 226, 227 to lift the pressure roller 231 enough to bring the upper surface of the closure sheet web into contacting

engagement with the printing type carried in the rims of the printing wheels, and at the same time disengaging the stop arm 224 from the pin 223 to start rotation of the printing wheels. The forward motion of the printing wheels imparted by forward feeding movement of the web and aided by the motor 217 will cause the wheels to imprint the upper surface of the web so long as the forward movement of the web continues. When the motion of the web stops, the air cylinder 232 will again be actuated to withdraw the pressure roller from the surfaces of the type. As this occurs, the motor 217 on the printing press frame will cause the printing wheels to continue their forward rotation until brought to rest by engagement of the pin 223 with the stop lever 224. Thus, the printing wheels make a complete revolution at each indexing movement, and while they may be adjusted to provide a printed legend of any length desired, the continuous rotation insures complete inking of the type during all conditions of operation.

The Sealing Press

As heretofore stated, the intermediate frame 19 consists of a pair of parallel longitudinal angle iron base pieces 191 having their outwardly projecting flanges drilled for bolting to a supporting floor surface, with transverse spacers at intervals along the length of the angles and with parallel uprights disposed at each end of these angle members to support the opposite ends of the conveyor tracks 11 and 12 in continuous uninterrupted passage through the printing station and sealing press of the machine.

The sealing press 29 has a generally rectangular base plate 235 resting directly on the upper edges of the vertical flanges of the angles 191 heretofore described, and is guided for sliding movement along the angles by a pair of guide brackets 236 (FIGURE 26) bolted to the opposite edges of the base plate and having downwardly disposed notches engaging the upper edge of the angle members. Longitudinal adjustment of this plate along the angle irons may thus be easily accomplished by sliding the plate back and forth to the position desired. Micrometer adjustment of the position of the base plate is facilitated by the provision of manually operated pinions 237 working against a pair of toothed racks 238 bolted on the outer faces of the longitudinal angle members 191, as will be described more fully in connection with the similar parts on the punch press 31.

The frame of the sealing press includes four vertical slide rods 241 extending through openings in the four corners of the base plate 235 and extending upwardly therefrom to the corresponding four corners of a top plate 242, with the individual rods secured to the top and bottom plates by locking nuts 243.

The top plate 242 serves as the mounting for a central air cylinder 244 which is carried by four parallel upright posts 245 and which has its piston shaft 246 interconnected to a parallel link system, best shown in FIGURES 29 and 30. The air cylinder is interconnected to the operating linkages associated therewith by a cross head 247 secured at the lower end of the downwardly extending piston shaft 246 and having its opposite faces slotted in a horizontal direction to receive paired rollers 248 mounted on the stub shafts 249 at the innermost ends of paired operating links 251. The operating links 251 have their outer ends pivoted on cross shafts 252 each of which extend between a pair of mounting blocks 253 and which also each support a pair of rocker arms 254, pivoted on the cross shafts 252 and having their inner ends connected to the links 251 by floating rods 255. The innermost ends of the four rocker arms 254 are coupled to a set of four downwardly extending pressure links 256, each of which have their upper ends affixed to the floating rods 255, with their lower ends passing through clearance openings 257 in the top plate 242 and their lower ends pivoted to the corner brackets 258 of an upper pressure plate 259. As will be observed from FIGURE 29, the upper pressure plate is thus disposed im-

mediately above the level of the conveyor tracks 11 and 12 and directly over the web of plastic material carried by the conveyor. A guide block 261 bolted to the top of the upper pressure plate 259 and slidable within an aperture in the top plate 242, serves to maintain the upper pressure plate in properly centered position with respect to the frame of the device.

The rocker arms 254 have their outer ends pivotally connected by pins 262 to a set of four downwardly extending links 263 which pass through the cut-away slots 264 in the top plate 242 and are coupled to lift pins 265 in pivot fittings 266 bolted to the upper face of a lower pressure plate 267 positioned below the level of the conveyor tracks and slidably mounted on the aforementioned vertical slide rods 241 by appropriate bushings 268.

The upper pressure plate carries a resistance heater or radio frequency heater platen 271 on its underside, while the lower pressure plate serves as a mounting for base platen 272 and a die member 273 having individual sealing flanges 274, each of the general proportions shown in FIGURE 29 and being arranged to register with and surround each of the molded package shapes when lifted to the position illustrated. Thus, it will be observed that on the down stroke of the air cylinder shaft 246 the parallel link rocker arms 254 will function to move the upper pressure plate 259 and heated platen 271 downwardly simultaneously with the upward motion of the sealing die 273, causing the sealing die and the heated platen to meet at the plane of the plastic web 13 and to form a marginal bond between the lowermost plastic sheet and the closure sheet 27 positioned thereon. If desired, the pressure applied to the plastic during the sealing operation may be limited by adjustment of vertical stop bolts 275 threaded into appropriate bosses 276 on the lower pressure plate 267 and adapted to abut the underside of the top plate 242 as the press closes.

The End Frame and Die Cutting Unit

The end frame 21 includes a pair of longitudinally extending angle irons 277 with upright members 278 at each end interconnecting with transverse angle irons 279 and supporting pieces 281 to provide a mounting for the conveyor tracks 11 and 12 as heretofore described, with a die cutting unit having a punch press 31 supported on the frame and arranged to stamp out the individual packages from the continuous web.

The punch press of the die cutting unit includes a slide frame consisting of four vertical slide bars 281, each secured at one corner of a flat base plate 282 by threaded nuts 283 tightened to the upper and lower surfaces of the base plate respectively, with an arrangement to provide for longitudinal adjustment of the position of the punch press frame along the supporting angle irons, in a manner to hold the entire punch press structure in precisely indexed relation with the conveyor chain. The upper ends of the slide bars of the frame are secured to a cross head 284 by lock nuts 285, and in the preferred practice of the invention the cross head 284 is provided with transverse reinforcing ribs 286 cast to provide an integral head member of great strength and rigidity. The base plate 282 of the punch press lies flat on the uppermost surfaces of the vertical flanges of the longitudinal angle iron members 277 of the end frame 21, and the inside opposite faces of these vertical flanges are grooved (FIGURE 32) to receive a locking plate 287 positioned immediately below the base plate 282, with its edges arranged to slide in the grooves or channels 288. Cap screws 289 extending through the base plate of the frame and threaded into the locking plate serve to clamp the entire assembly into rigid, immovable relationship.

Ease of adjustment of the punch press 31 along the longitudinal angle irons 277 of the end frame 21 is assured by mounting a toothed rack 291 on the outer face of the vertical flange of each of the angle irons 277 and providing on each side a coacting pinion 292 rotatably

mounted in a vertical bore through a fitting consisting of spacers 293 and 294 secured to the upper and lower faces of the base plate 282, with each pinion having a squared upper end 295 projecting from the fitting whereby it may be rotated by a hand tool to effect micrometer adjustment of the press along the angle iron slides upon which it is supported.

The driving mechanism of the punch press is mounted between paired end plates 296 and 297 (FIGURE 31) welded to the upper surface of the main base plate 282 and having two separate crankshafts 298 and 299 extending therebetween and journalled in hubs therein. As shown, the plates 282, 296 and 297 are welded as an integral unit and provided with a plurality of reinforcing flanges. An electric motor 301 for driving the punch press is mounted adjacent the frame thereof, as by the use of a cross plate 302 resting on the upper edges of the longitudinal angle iron members 277 secured thereto. The power shaft of the motor 301 is belted directly to the outside of a flywheel 303 by a plurality of flexible V-belts, and the flywheel is provided with a conventional single-stroke clutch 304 whereby it may run free on its pinion shaft 305 under idling conditions, or may be coupled with its supporting shaft to rotate the driving pinion 306, which is in constant mesh with paired gears 307 and 308 mounted on crankshafts 298 and 299.

The shafts 298 and 299 supporting the gears 307 and 308 are journalled in appropriate bearings in the frame plates 296 and 297 of the press, and each shaft carries a pair of eccentrics 311 and 312 on which paired connecting rods 313 and 314 are mounted, with all four of the connecting rods extending upwardly from their respective eccentrics and secured to wrist pins 315 and 316, each journalled in bearing blocks 317 which may be formed as an integral part of the pressure plate 318 of the press.

The cross head 284 of the press has a bottom plate 321 on which clamping dogs 322 are secured by cap screws 323 in a manner to support the inverted base flanges of a cutting platen 324 which has its downwardly directed cutting face disposed immediately above the plane of the web 13 as carried through the machine by the opposite conveyors on the tracks 11 and 12.

The lower pressure plate 325 of the press is drilled at its corners and provided with four slide bushings 326 by which it is arranged for vertical sliding movement on the slide bars 281 heretofore described, and the upper face of the lower pressure plate has clamping dogs 327 held in position by inverted cap screws 328 and engaging the base flange of a cutting die 329.

The underside of the lower pressure plate 325 carries a threaded adjusting disc 331 secured to the guide plate as by the cap screws 332, and adjustment of the uppermost limits of the stroke of the press is provided by a rotatable adjusting collar 333 threaded to the disc 331 and having its base secured to the aforementioned pressure plate 325 on inwardly disposed flange 334, extending under the peripheral edges of a circular guide disc 335 secured to the plate 318 by machine screws 336 extending downwardly between the bearing block of the pressure plate and accessible from the underside of the machine. Adjustment of the die is accomplished by rotating the collar 332 to raise the lower pressure plate 325 to the precise height desired. For convenience, this may be accomplished by rotation of the squared end of a vertical stub shaft 337 mounted in the bracket 338 on the pressure plate and having a small sprocket 339 interconnected to a peripheral sprocket 341 on the collar 333 by means of a chain 342.

A production counter 343 may be connected to one of the drive shafts of the press, if desired.

The Control Circuits

The control circuitry of the machine is divided into the separate units best shown in FIGURES 33, 34 and 35 of the drawings wherein it will be observed that the electrical apparatus of the main frame (indicated by the

broken-line outline 17) is interconnected with the control devices on the panel 22, also indicated by broken lines, by a series of conductors which form, in effect, a cable 351. Similarly, interconnections between the main frame 17 and the heating and forming units 23 and 24 are established through the cable 352, while connections between the main frame 17 and the printing unit 28 are through the cable 353 and the connections to the sealing press 29 are through the cable 354. Similarly, the electrical interconnections between the main frame 17 and the cutting press 31 are established through an interconnecting cable 355. It will be understood, of course, that these interconnecting cables may be provided with suitable connectors or terminal strips as required in the manner diagrammatically indicated at 356 and 357 (FIGURE 33).

In the main frame there is provided a single phase alternating current power input line consisting of the conductors 358 and 359 which extend through conventional fuses to a solenoid switch 361, which is in turn actuated by a manual switch 362 on the control panel 22 and connected to an indicator lamp 364 to indicate "On" position. The alternating current input supply from the switch 361 is applied to the primary winding 363 of a step-down input transformer 371 and is also carried through line conductors 365 and 366 to the motor control switch 367 and thence through the cable 355 to the end frame and cutting press of the machine where the circuit controls the solenoid winding 368 of a power switch 369 through which the punch press motor 361 is supplied with 220 volt, 3 phase alternating current power from triple supply leads 372. The single phase alternating current voltage from the main switch 361 is also carried through leads 373 and 374 of the main control cable to the vacuum pump 52 (FIGURE 34) and, if desired, the circuit may also extend to a blower 375 controlled by a separate switch 376 to cool the forming press during molding operations.

The electrical heating units 33 of the preheater 23 are controlled by the manual switch 377 which actuates the solenoid 378 of their power switch 379 to energize the individual resistances through their thermostats 381 provided for individual control of the nine separate circuits, three of which are interconnected across each pair of the separate three-phase power input lines 382.

The control panel 22 is also provided with a "Start" button 383 and with individual switches 384, 385, 386 and 387 for control of the forming press 24, the printing unit 28, sealing press 29 and the cutting press 31, respectively. The sealing press 29 has its radio frequency generator 388 separately supplied with power through three phase input lines 389. Also, a pair of time controlled switches 391 and 392 are arranged with the circuitry shown so that by operation of their internal motors 393 and 394 the switches may be opened and closed at any desired intervals.

The switch 384 which controls the primary functions of the vacuum forming press 24 does so by energizing the solenoid winding 396 of a contactor 397 having four single pole, double-throw switches connected as shown. Also, the button 383 has an auxiliary switch 391 to condition the circuitry for single cycle operation or for automatic production.

This "Start" button 383, functioning in connection with the contactor 397 and related circuitry, thus serves to initiate operation of the machine by energizing the windings 398 and 399 of the solenoid valve 401 which controls the air cylinder 96. The piston rod 95 of the air cylinder is in turn connected with paired contactors 402 and 403 as shown. The contactor 397 is similarly connected to the paired solenoid windings 404 and 405 of the solenoid valve 406 which serves to supply air to the main lift cylinder 153 of the forming press 24. The piston shaft 157 of air cylinder 153 is mechanically connected with a series of contactors 407, 408, 409, 411, 412 and 413 as shown in FIGURE 34. Contactor 397 is also connected to the

solenoid windings 414 and 415 of a valve 416 which controls the supply of air to the cylinder 172 of the forming press. The piston rod 171 of the cylinder 172 is also arranged to actuate a contactor 417, and the printer switch 385 is arranged to energize the solenoid windings 418 and 419 of valve 421 to supply air to the air cylinder 232 of the printing unit 28. The cutting press switch 387 is interconnected through cable 355 to the terminal strip 422 of the clutch 304 on the punch press unit 31 heretofore described.

When the machine is to be started, the push button 383 may be depressed with the auxiliary switch 391 set for single cycle or automatic control as desired, and the circuitry illustrated will operate through the contactor 397 and the several individual contactors connected with the air cylinder of the mechanism, to cause the individual units of the machine to function in synchronism with each other, and in timed relation with the advancing movement of the conveyor.

Thus the plastic web 13, carried between the conveyor tracks 11 and 12, will be first subjected to preheating as it passes below the electrical resistance heaters 33 of the preheating unit 23, after which it will be drawn into the forming press 24 where a segment of the plastic will be clamped between the clamping ring 181 and the mold 146 while the vacuum valve 167 is opened to draw the softened plastic downwardly into the mold cavities in the manner shown in FIGURE 5. When the forming is completed, the run-out of timer 394 (with its contacts 392) will shut off the vacuum butterfly valve 167 which in turn will actuate switch 417. Closure of the contacts on switch 417 will cause the necessary circuitry to operate the main air cylinder 153 (and lower the mold) and inject a blast of air from the exhaust of air cylinder 153 into the mold of the forming press. This air will insure release of the plastic shape from the mold as the mold is drawn downwardly to a position sufficiently below the web so that the conveyor and web may move forward without interference from the mold.

Further indexing motion of the conveyor will bring the open-topped package cavities into the loading station 18 where they may be filled. This can be done either manually or by some automatic filling devices such as diagrammatically illustrated at 34 in FIGURE 2. After filling, the package forms continue to advance through the sealing press 29 where they are united with the closure sheet by the die 273 acting against the heated platen 271 as heretofore described. After sealing, the packages are carried to the cutting press 31 by the further indexing action of the conveyor chains and the action of the cutting press die 299 serves to substantially sever each individual package from the web, but leaves frangible interconnecting tabs or fibres strong enough to carry the loaded packages out of the punch press to the discharge end of the conveyor, where the individual packages may be removed from the web by any appropriate means, as by drawing the web abruptly around a bar or appropriate cutting tool.

Résumé

From the foregoing it will be apparent that the mechanism heretofore described accomplishes the objects of the present invention in that it provides an automatically operating package forming machine capable of mass production of preformed molded plastic packages and so arranged that the packages may be loaded either manually or by automatic devices, while still in the package forming machine and while still an integral part of the plastic web. By this expedient the relative positioning and orientation of the package cavities is closely controlled during and after the filling, printing, sealing and die-cutting operations, yet without the need of individual handling of the package capsules.

In addition it is to be noted that the machine disclosed herein is capable of a wide range of adjustment whereby it is suited to the production of packages of many and

various sizes, shapes and contours, and is adapted to utilize, without undue waste, plastic web of any convenient width up to the maximum capacity for which the machine is designed. It is to be appreciated that adjustment for various widths of plastic web may be conveniently made by merely shifting the position of the movable conveyor track, and that the conveyor requires no adjustment to suit the different thicknesses of plastic webs commonly used. Adjustment for plastics having different characteristics may easily be accomplished by relatively simple adjustments of the timing devices, the heating means and the control instrumentalities illustrated in the schematic diagrams, whereby the machine may be caused to operate at the maximum speed consistent with adequate time for heating, forming and sealing of the particular plastics involved.

Having thus described the invention, what I claim as new and desire to protect by United States Letters Patent is:

1. In an automatic packaging machine of the type employing continuous-web stock of sheet plastic material for the manufacture of three-dimensional hollow package forms, a conveyor comprising a pair of parallel, elongated conveyor tracks with each track adjacent one of the two opposite edges of the plastic web; each of said tracks including a supporting beam with a sprocket at each end with an elongated loop of endless chain extending between the sprockets; with the chain loops lying substantially in the plane of the plastic web and extending outwardly from each edge thereof whereby one span of each loop is positioned parallel with and closely adjacent each opposite edge of the plastic web, and the opposite span of each chain loop is located remotely from the edge of the web and away from the surface thereof; each of the conveyor chains carrying a series of grippers including paired fingers in opposed relation to each other with one end of each finger secured on the chain and the other ends of the fingers extending laterally from the chains sufficiently to overlie the adjacent edge of the plastic web; said fingers being spaced apart from each other, with inwardly extending jaw portions at their ends adapted to engage the plastic web at a location inwardly from its extreme edge; the gripper fingers being urged toward each other and the jaw portions being provided with teeth to engage and support the plastic; in combination with conveyor operating devices consisting of elongated teeth on the aforesaid chain sprockets to separate the opposed gripper fingers from each other in zones near the ends of each chain loop by the engagement of wedge surfaces on the sprocket teeth with cam surfaces on the inner faces of the fingers, whereby the conveyor grippers passing over the sprocket at the intake end of the conveyor are individually and successively opened to engage the plastic sheet to be carried thereby, while the grippers passing over the sprockets at the discharge end of the conveyor are individually and successively opened to release the plastic.

2. In an automatic packaging machine of the type employing continuous-web stock of sheet plastic material for the manufacture of three-dimensional hollow package forms, a conveyor comprising a pair of parallel, elongated conveyor tracks with each track adjacent one of the two opposite edges of the plastic web; each of said tracks including a supporting beam with a sprocket at each end with an elongated loop of endless chain extending between the sprockets; with the chain loops lying substantially in the plane of the plastic web and extending outwardly from each edge thereof whereby one span of each chain loop is positioned parallel with and closely adjacent each opposite edge of the plastic web, and the opposite span of each chain loop is located remotely from the edge of the web and away from the surface thereof; each of the conveyor chains carrying a series of grippers including paired fingers in opposed relation to each other with one end of each finger secured on the chain and the

other ends of the fingers extending laterally from the chains sufficiently to overlie the adjacent edge of the plastic web; said fingers being spaced apart from each other, with inwardly extending jaw portions at their ends adapted to engage the plastic web at a location inwardly from its extreme edge; the gripper fingers being urged toward each other and the jaw portions being provided with teeth to engage and support the plastic; in combination with conveyor operating devices to separate the opposed gripper fingers from each other in zones near the ends of each chain loop by the engagement of wedge surfaces on the sprocket teeth with cam surfaces on the inner faces of the fingers, whereby the conveyor grippers passing over the sprocket at the intake end of the conveyor are individually and successively opened to engage the plastic sheet to be carried thereby, while the grippers passing over the sprockets at the discharge end of the conveyor are individually and successively opened to release the plastic.

3. In an automatic packaging machine of the type employing continuous-web stock of sheet plastic material for the manufacture of three-dimensional hollow package forms, a conveyor comprising a pair of parallel, elongated conveyor tracks with each track adjacent one of the two opposite edges of the plastic web; each of said tracks including a supporting beam with a sprocket at each end with an elongated loop of endless chain extending between the sprockets; with the chain loops lying substantially in the plane of the plastic web and extending outwardly from each edge thereof whereby one span of each chain loop is positioned parallel with and closely adjacent each opposite edge of the plastic web, and the opposite span of each chain loop is located remotely from the edge of the web and away from the surface thereof; each of the conveyor chains carrying a series of grippers positively urged toward each other and provided with teeth to engage and support the plastic; in combination with conveyor operating devices consisting of elongated teeth on the aforesaid chain sprockets to separate the opposed grippers from each other in zones near the ends of each chain loop by the engagement of wedge surfaces on the sprocket teeth with cam surfaces on the inner faces of the fingers, whereby the conveyor grippers passing over the sprocket at the intake end of the conveyor are individually and successively opened to engage the plastic sheet to be carried thereby, while the grippers passing over the sprockets at the discharge end of the conveyor are individually and successively opened to release the plastic.

4. In an automatic packaging machine of the type employing continuous-web stock of sheet plastic material for the manufacture of three-dimensional hollow package forms, a conveyor comprising a pair of parallel, elongated conveyor tracks with each track adjacent one of the two opposite edges of the plastic web; each of said tracks including a supporting beam with a sprocket at each end with an elongated loop of endless chain extending between the sprockets; with the chain loops lying substantially in the plane of the plastic web and extending outwardly from each edge thereof whereby one span of each loop is positioned parallel with and closely adjacent each opposite edge of the plastic web, and the opposite span of each chain loop is located remotely from the edge of the web and away from the surface thereof; each of the conveyor chains carrying a series of grippers including paired fingers in opposed relation to each other with one end of each finger secured on the chain and the other ends of the fingers extending laterally from the chains sufficiently to overlie the adjacent edge of the plastic web; the gripper fingers positively urged toward each other and provided with teeth to engage and support the plastic; in combination with conveyor operating devices consisting of elongated teeth on the aforesaid chain sprockets to separate the opposed gripper fingers from each other in zones near the ends of each chain loop.

5. In an automatic packaging machine of the type em-

ploying sheet plastic material for the manufacture of three-dimensional hollow package forms, a conveyor comprising a pair of parallel, elongated conveyor tracks with each track having at least one guide channel adjacent one of the two opposite edges of the plastic sheet and extending longitudinally along the track; each of said tracks including a sprocket at each end and an elongated loop of endless chain extending between the sprockets; with the chain loops lying substantially in the plane of the plastic sheet and extending outwardly from each edge thereof whereby one span of each chain loop is positioned parallel with and closely adjacent each opposite edge of the plastic web, and the opposite span of each chain loop is located remotely from the edge of the web and away from the surface thereof; each of the conveyor chains carrying a series of grippers including paired fingers consisting of flat leaf springs in opposed relation to each other with one end of each finger secured to slide means on the chain adapted to move along the aforesaid guide channels and the other ends of the fingers extending laterally from the chains sufficiently to overlie the adjacent edge of the plastic and positively urged toward each other to engage and support the plastic; the conveyor also including operating devices consisting of elongated teeth on the aforesaid chain sprockets to separate opposed grippers from each other in zones near the ends of each chain loop by the engagement of wedge surfaces on the sprocket teeth with cam surfaces on the inner faces of the fingers, whereby the conveyor grippers passing over the sprocket at the intake end of the conveyor are individually and successively opened to engage the plastic sheet to be carried thereby, while the grippers passing over the sprocket at the discharge end of the conveyor are individually and successively opened to release the plastic.

6. In an automatic packaging machine of the type employing sheet plastic material for the manufacture of three-dimensional hollow package forms, a conveyor comprising a pair of parallel, elongated conveyor tracks with each track having at least one guide channel adjacent one of the two opposite edges of the plastic sheet and extending longitudinally along the track; each of said tracks including a sprocket at each end and an elongated loop of endless chain extending between the sprockets; with the chain loops lying substantially in the plane of the plastic sheet and extending outwardly from each edge thereof whereby one span of each chain loop is positioned parallel with and closely adjacent each opposite edge of the plastic web, and the opposite span of each chain loop is located remotely from the edge of the web and away from the surface thereof; each of the conveyor chains carrying a series of grippers extending laterally from the chains sufficiently to overlie the adjacent edge of the plastic web; the grippers guided along the beams of the conveyor tracks by slide means within the aforesaid guide channels on the aforementioned supporting beam thereof, and positively urged toward each other to engage and support the plastic; the conveyor also including operating devices consisting of elongated teeth on the aforesaid chain sprockets to separate opposed grippers from each other in zones near the ends of each chain loop by the engagement of wedge surfaces on the sprocket teeth with cam surfaces on the inner faces of the fingers, whereby the conveyor grippers passing over the sprocket at the intake end of the conveyor are individually and successively opened to engage the plastic sheet to be carried thereby, while the grippers passing over the sprocket at the discharge end of the conveyor are individually and successively opened to release the plastic.

7. In an automatic packaging machine of the type employing sheet plastic material for the manufacture of three-dimensional hollow package forms, a conveyor comprising a pair of parallel, elongated conveyor tracks with each track having at least one guide channel adjacent one of the two opposite edges of the plastic sheet and extending longitudinally along the track; each of said

tracks including a sprocket at each end and an elongated loop of endless chain extending between the sprockets; with the chain loops lying substantially in the plane of the plastic sheet and extending outwardly from each edge thereof whereby one span of each chain loop is positioned parallel with and closely adjacent each opposite edge of the plastic web, and the opposite span of each chain loop is located remotely from the edge of the web and away from the surface thereof; each of the conveyor chains carrying a series of grippers including paired fingers consisting of flat leaf springs in opposed relation to each other with one end of each finger secured to slide means on the chain adapted to move along the aforesaid guide channels and the other ends of the fingers extending laterally from the chains sufficiently to overlie the adjacent edge of the plastic web; the grippers guided along the beams of the conveyor tracks by slide means on the aforementioned supporting beam thereof, and positively urged toward each other to engage and support the plastic; the conveyor also including operating devices to separate opposed grippers from each other in zones near the ends of each chain loop whereby the conveyor grippers passing over the sprocket at the intake end of the conveyor are individually and successively opened to engage the plastic sheet to be carried thereby, while the grippers passing over the sprocket at the discharge end of the conveyor are individually and successively opened to release the plastic.

8. In an automatic packaging machine of the type employing sheet plastic material for the formation of three-dimensional hollow package forms, the combination of a conveyor comprising an elongated loop of endless chain adjacent at least one edge of the plastic sheet material with a sprocket at each end of said loop of chain and with the chain loop lying substantially in the plane of the plastic and extending outwardly thereof, whereby one span of said chain loop is positioned parallel with and closely adjacent the edge of the plastic and the opposite span of each chain loop is located remotely from the edge of the sheet and away from the surface thereof, with the conveyor chain carrying a series of grippers each consisting of a pair of opposed fingers, with one end of each finger secured on the chain and the other ends of the fingers extending laterally from the chains sufficiently to overlie the edges of the plastic sheet material, the grippers being urged toward each other and provided with means to engage the plastic; the conveyor also including operating devices consisting of elongated teeth on the aforesaid chain sprockets to separate the grippers in zones near the ends of each chain loop by the engagement of wedge surfaces on the sprocket teeth with cam surfaces on the inner faces of the finger members, whereby the conveyor grippers passing over the sprocket at the feed end of the conveyor are each individually and successively opened to engage the plastic sheet carried thereby, while the grippers passing over the sprocket at the discharge end of the conveyor are individually and successively opened to release the plastic.

9. In an automatic packaging machine of the type employing sheet plastic material for the formation of three-dimensional hollow package forms, the combination of a conveyor comprising an elongated loop of endless chain adjacent at least one edge of the plastic sheet material with a sprocket at each end of said loop of chain and with the chain loop lying substantially in the plane of the plastic and extending outwardly thereof, whereby one span of said chain loop is positioned parallel with and closely adjacent the edge of the plastic and the opposite span of each chain loop is located remotely from the edge of the sheet and away from the surface thereof, with the conveyor chain carrying a series of grippers each consisting of a pair of opposed fingers, with one end of each finger secured on the chain and the other ends of the fingers extending laterally from the chains sufficiently to overlie the edges of the plastic sheet material, the

grippers being urged toward each other and provided with means to engage the plastic; the conveyor also including operating devices to separate the grippers in zones near the ends of each chain loop whereby the conveyor grippers passing over the sprocket at the feed end of the conveyor are each individually and successively opened to engage the plastic sheet carried thereby, while the grippers passing over the sprocket at the discharge end of the conveyor are individually and successively opened to release the plastic.

10. In an automatic packaging machine of the type employing sheet plastic material for the formation of three-dimensional hollow package forms, the combination of a conveyor comprising an elongated loop of endless chain adjacent at least one edge of the plastic sheet material with a sprocket at each end of said loop of chain and with the chain loop lying substantially in the plane of the plastic and extending outwardly thereof, whereby one span of said chain loop is positioned parallel with and closely adjacent the edge of the plastic and the opposite span of each chain loop is located remotely from the edge of the sheet and away from the surface thereof, with the conveyor chain carrying a series of grippers extending laterally from the chains sufficiently to overlie the edges of the plastic sheet material, the grippers being urged toward each other and provided with means to engage the plastic; the conveyor also including operating devices consisting of elongated teeth

on the aforesaid chain sprockets to separate the grippers in zones near the ends of each chain loop by the engagement of wedge surfaces on the sprocket teeth with cam surfaces on the inner faces of the finger members, whereby the conveyor grippers passing over the sprocket at the feed end of the conveyor are each individually and successively opened to engage the plastic sheet carried thereby, while the grippers passing over the sprocket at the discharge end of the conveyor are individually and successively opened to release the plastic.

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UNITED STATES PATENT OFFICE
CERTIFICATION OF CORRECTION

Patent No. 3,029,007

April 10, 1962

Charles Hepner

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 42, for "bubble" read -- bubbles --; column 3, line 17, for "thickness" read -- thicknesses --; column 4, line 73, for "a" read -- the --; column 7, line 47, for "16" read -- 76 --; column 10, line 20, for "monetary" read -- momentary --; column 19, line 23, for "plactic" read -- plastic --; column 18, line 49, beginning with "4. In an automatic" strike out all to and including "each chain loop." in line 74, same column 18; column 20, line 29, beginning with "8. In an automatic" strike out all to and including "release the plastic." in line 10, column 22, comprising claims 8, 9 and 10; columns 18 and 19, claims now numbered 5, 6 and 7, should be renumbered as claims 4, 5 and 6; in the heading to the printed specification, line 7, for "10 Claims." read -- 6 Claims. --.

Signed and sealed this 6th day of November 1962.

(SEAL)

Attest:

ERNEST W. SWIDER

Attesting Officer

DAVID L. LADD

Commissioner of Patents